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**THE DEVELOPMENT OF PROFESSIONAL MANAGEMENT
IN THE PUBLIC SECTOR OF THE UNITED KINGDOM
FROM 1855 TO 1925:**

The Case of the Ordnance Factories

by

John Black BEd(Hons) MA(Ed) MA

**Submission of thesis
as part of consideration
for the award of Doctor of Philosophy degree**

DEDICATION

This thesis is dedicated to the Library staff of the Open University at Milton Keynes who were unfailing in their endeavours with my repeated requests; and to my supervisor, Professor A.W. Thomson OBE, who never doubted my ability to undertake this research. This thesis is also dedicated to the memory of Colonel G.H.H. Dunkerton L/RAMC (1912-1998), Commanding Officer British Military Hospital Munster 1967-1969.

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Numerous people in a variety of institutions have afforded the author generous advice and assistance in the compilation of this thesis. In particular, however, my thanks must be recorded to the following:

- The staff of the Imperial War Museum.
- The staff of the National Army Museum.
- The staff, and in particular the staff of the public reading room, of the Public Record Office, Kew, London.
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- Mr. Alan Turner, Honorary Secretary of the Royal Arsenal Historical Society.
- Miss J. Cooper, whose father worked at the Royal Arsenal, Woolwich and who gave the author much advice and support.
- Mrs. Hazel Black, my ever-patient wife, who supported me throughout.

The term 'Ordnance Factories' was not officially used until 1890, after the publication of the official Morley Report (C 5116) 1887. Prior to this the official term used was 'Government Manufacturing Departments', sometimes abbreviated by the contemporary media to the 'Woolwich Departments'.

As not all the Ordnance Factories were located at Woolwich, and to produce a standardised description throughout this thesis, the term 'Ordnance Factories' has been used.

Background

This thesis is an examination of the reforms of the Ordnance Factories from 1855 due to the development of a professional management ethos. In this context the thesis has three broad objectives:

1. To assess the development of professional management in the Ordnance Factories based on double-entry book-keeping (DEB), costing and scientific management.
2. To assess the origins of professional management with particular reference to the concept of the soldier technologist.
3. To challenge the myth which has grown up identifying the Ministry of Munitions as being the catalyst for management change, particularly in relation to costing, DEB and scientific management.

In the light of these objectives, it is interesting that in 1993 the British Conservative Chancellor of the Exchequer, during his Budget Address to the House of Commons, used the opportunity to say that "the present cash accounting system has served the government well over many years" (Cm 2929, July 1995: 1). However, this cash system had limitations as to the information which it provided, notably on capital, resource and budget accounting. The then Chancellor of the Exchequer in his 1995 Budget Address considered that the proposed new government accounting system would probably prove to be the most important reform of the civil service accounting system during the past century.

In this context the proposed new initiatives of Resource Accounting and Budgeting (RAB) (or Project CAPITAL as it is known in the Ministry of Defence (MoD)) into central government accounting are not new. Similar reforms were

introduced into the War Office controlled Ordnance Factories from 1862, a fact not known by the Chancellor of the Exchequer, nor did the Chancellor refer to the cost accounting experiment within the British Army from 1917 to 1925. This experiment had directly influenced the later Crick Report findings of 1950 into Forms of Government Accounts (Cmnd 7929). Crick was averse to any form of commercial accounting principles being introduced into government accounts and cited the assumed failure of the earlier cost accounting experiment in the Army as a reason.

This study has been conducted by first-hand research among archive files and documentary records located in the National Army Museum, the Indian and Oriental Museum of the British Library, the London School of Economics (LSE) and the Public Record Office. This first-hand research also included a scrutiny of published papers in contemporary institutional journals including *The Accountant*, *Cost Accountant* and *The Incorporated Accountant*, as well as the proceedings of the Institution of Civil Engineers.

Abstract

This thesis is an exploration into the development and professionalism of management in the Ordnance Factories from 1855 to 1925. Writing in 1969, Ashworth commented that:

"Naval historians have usually been concerned much more with warfare, politics, the careers of great leaders than with the business side of the service. The technical characteristics of warships and their armament have received much attention, but the economic question (apart from the simple demand for money), which have been inseparably linked with technical advance, has attracted less study. Yet there are several ways in which the provision and running of a large and growing navy must have a peculiar significance and interest for the economic historian." (Ashworth, 1969: 491)

This is also similar to the development of the Army from 1855.

Recent historians have focused on the Ministry of Munitions as the catalyst for management change within government departments. In particular Loft (1986, 1988, 1994) and Marriner (1980) have explored the change in government accounting procedures within the Ministry of Munitions due to the proliferation of professional accountants into the wartime government as temporary civil servants. There is a notion in history that the pre-1915 War Office was regarded as an inefficient organisation whereas the temporary and monolithic Ministry of Munitions is heralded as the organisation of change, having the services of "the men of push and go" (Lloyd-George, 1938; Adams, 1978).

The reforms of the Ordnance Factories from 1862 were mainly accounting driven and the catalyst for these changes were probably due to the logistical failures of the British Army in the Crimean War. The reforms themselves were undertaken by civil servants although there was a nucleus of military talent, the concept of the soldier technologist was never as influential as the American experience. However,

the Ordnance Factories did evolve into a factory system in the post-Crimean era, whereas the contemporary engineering industry was still dominated by the myth of the craft skill, subcontracting and a workshop ethos.

By 1915 the Ordnance Factories reflected a high degree of professionalism within its management ethos which probably was better than that experienced by the contemporary private sector.

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CHAPTER 1

Setting the Scene:

**Purpose, Scope, Methodology
and Underlying Factors**

Introduction

Hypothesis

The objective of this thesis is to examine the development of professional management in the public sector of the United Kingdom from 1855 to 1925. In particular, this thesis focuses on the War Office administered Ordnance Factories and especially the accounting dimensions which in turn initiated other managerial reforms. At the time of writing this thesis (1999), the Royal Ordnance Factories (ROF) have been privatised as Royal Ordnance and are part of British Aerospace munitions group.

What was so special about the Ordnance Factories in the period under review? This thesis will demonstrate that in the period from 1855 to 1925 the Ordnance Factories were the largest engineering and technological factories in Britain, where integrated management techniques were developed from the emergence of three inter-related concepts which were accounting-driven. These were:

- Costing and accounting systems, including the double entry method of book-keeping from 1864.
- The production process and interchangeable parts of rifle manufacture, introduced into the Royal Small Arms Factory, Enfield in 1857, and into the Woolwich-based Royal Gun Factory five years later in 1862. The process of interchangeability was based on "the American system of manufactures" (Hounshell, 1984, Appendix 1).
- Scientific management, labour relations and flexibility, including pieceworking, first introduced into the Royal Carriage Department, Woolwich in 1855 (WO 47/2755, p.1535).

The main hypothesis being put forward is that a professional management ethos

was emerging within the Ordnance Factories from the mid-nineteenth century onwards, which was in many respects more sophisticated than in the contemporary private sector. One major intention of this thesis is to show how the varying areas of reform, accounting, production process control and industrial relations interacted.

Another, although secondary dimension developed in this thesis relates to the concept of the soldier-technologist. Systems of military organisation and procedures provided a framework which was most closely allied to management systems because it involved planning and command systems. This framework was a better basis for the emergence of coherent systems of control than the uncertainties of the private sector. In America much credit has been given to the soldier-technologist (Chandler, 1977; Hoskin and Macve, 1986, 1988, 1994, 1997). If the individuals are not as recognisable in Britain, the underlying systems are. The soldier-technologist component within the British and Indian Ordnance Factory model tended to imply a more efficient management structure. It must also be appreciated that these reforms, along with contemporary naval administrative reforms, were conducted within a political climate of Victorian economic liberalism (Ashworth, 1969: 495-521) which acted as a catalyst for internal reform and efficiencies. This point is further discussed later.

Another secondary argument put forward in this thesis is that the initiatives established in the First World War, primarily in the Ministry of Munitions, were inherited from the pre-1914 Ordnance Factories. Recent research concerning ordnance and munitions supply and the Ministry of Munitions has tended to ignore the pre-1914 reforms, as did the official though unpublished *History of the Ministry of Munitions* (Adams, 1978; Hinton, 1973; Loft, 1988, 1994; Marriner, 1994).

The aim of this thesis is to explain how the separate areas of reform were

synthesised and interfaced with each other. Such reforms include accounting, production process reforms and industrial relations.

- Accounting reforms were the driving force leading to the other reforms. Chapter 4 will explain how new accounting systems were introduced, first into the Royal Arsenal, Woolwich. The accounting reforms were set against the backdrop of the immediate Crimean War era and the advent of the multi-calibred Armstrong Gun and the development of the 'American system of manufacture' at the Enfield Rifle Factory. The accounting reforms were emerging contemporaneously with the rapid development of a factory production system within the Ordnance Factories, particularly the Royal Small Arms Factory and the Royal Gun Factory.
- The development of the factory system in the Ordnance Factories had a major impact on the production process and its control. Engineers such as Armstrong, Anderson and Fraser reorganised the culture of workshop production to one of conveyor belt production where the concept of accounting, accountability and control was accepted very quickly.
- This was achieved through an industrial relations process of the paternalistic employer concept, pieceworking, job rotation, scientific management and better-than-average wages compared to the private engineering / metal industry. There was also scope for promotion of shop floor workers to clerical and supervisory grades. Throughout most of the period from 1855 to 1925, the workforce experienced a long-term career due to long production runs.

All three components were closely linked and interfaced with each other. The major driving force was, however, the accounting reforms. Urwick and Brech, almost

fifty years ago, recognised that "the history of control in management is the story of evolution of accounting and cost accounting" (1953, vol.2: 15).

The complementary relationship between accounting, production process control and industrial relations established principles within the Victorian Ordnance Factories or conveyor-belt production and interchangeability, scientific management and labour flexibility. Such techniques produced cheap and efficient munitions on long production runs, compared with those produced under contract. The catalyst for these reforms lay in the political climate of the post-Crimean War Victorian society. This was the heyday of Victorian liberalism as manifest in *laissez-faire* doctrine. Victorian liberalism was driven by an ever parsimonious Treasury and the Victorian taxpayer who was after "more bang for his buck".

Finally, an exploration of the reforms of the Ordnance Factories prior to 1915 is also important because it can expose some of the myths of history relating to the Ministry of Munitions which have become part of the legend and incorporated into the historiography of welfarism and the First World War. This is particularly so with the work of Hinton and the first Shop Stewards' Movement (1973).

Questions to be addressed

The fundamental questions to be addressed in this thesis are as follows:

- Were the management reforms of the Ordnance Factories a result of the transition from workshop to factory production from 1855 onwards? The reforms from 1855 onwards were similar to those of the American Federal Armories and the private American armories and other enterprises from the mid-nineteenth century onwards, on which Chandler commented: "These

processes differed from earlier ones in their potential for exploiting the unprecedented cost advantages of the economies of scale and scope" (Chandler, 1994: 21).

- Was the fact that the Ordnance Factories in Britain were public sector institutions a major factor in the developing management reforms which occurred from 1855 onwards? In this context, consideration will be given to the failure of these reforms to develop in the private sector in Britain due to the constraints of family capitalism (Payne, 1967; Chandler, 1994). Also Cooper (1984) relates that British entrepreneurs and craftsmen failed to appreciate or to humanise new technology. She cites the failure of the Portsmouth system of manufacture pioneered at the Naval Dockyard, Portsmouth as an example of this.
- Was the prevailing political economic system of *laissez-faire* a contributory factor in the development reforms of the Ordnance Factories?
- Who were the internal and external innovators of the reforms?
- How far did the role of the soldier-technologist have a major bearing on the reforms of the Ordnance Factories?
- What were the major differences between the management of the Ordnance Factories and the engineering / metal industry in the private sector?
- Were the alleged reforms as introduced in the Ministry of Munitions after 1915 already well established in the Ordnance Factories prior to 1914?

Management history and its relationship with economic history and other related areas of history

Management history cannot be explored in isolation and must be seen as part of business history. However, the purpose of management history is to explore how historical players, such as entrepreneurs, managers, supervisors and indeed military officers and civil servants utilised the factors of production to the best advantage of the enterprise or, in the context of a public institution, the taxpayer. Nor did these personnel exist in a vacuum. Both historically and in a contemporary setting, businesses and public sector institutions are required to conform to the rules established by legal processes. The demand for their goods and services may be influenced through domestic and international consumer demand, the shape of the economy and the standard of living. Political ideology can also influence the decisions and success or survival of businesses and their managers.

In this respect the nineteenth-century Ordnance Factories existed in a climate of political and economic liberalism where the prevailing philosophy was to minimise the role of the state. This philosophy re-emerged in the late twentieth century under the premiership of Mrs. Thatcher, 1979-90, with monetarism, privatisation, a reduction of the state role and the support of the enterprise society (Jeremy, 1998: 9). The fundamental difference between the *laissez-faire* philosophy and Thatcherism in terms of the Ordnance Factories was that they not only survived from 1855 but actually increased in size and technological support, whereas under Mrs. Thatcher's administration they were privatised.

War itself is a major factor in the influence of business development and activity as the previous factors do change, i.e. trade embargoes, increased state

intervention and the decisions to manufacture munitions rather than domestic goods and services. Total war as experienced during the First and Second World Wars created opportunities and encouraged business managers in the private sector to move into government. The influence of major entrepreneurs and industrial managers who worked for the government in both wars (i.e. the Ministry of Munitions 1915-19, the Army and Navy Contracts Departments, the Ministry of Supply and Ministry of Aircraft Production 1939-45) was enormous.

But in the acclaim of the private sector influence in the realm of government in both World Wars, the role and success of the Ordnance Factories from 1855 onwards has been neglected. Indeed, a supposition has grown to suggest that they were inefficient. It is the aim of this thesis to address this neglect.

Generally, managers act and react to certain internal and external situations. Management history complements business history in this by attempting to analyse and explain how and why managers adopted certain procedures, including tool such as accounting, production process control and labour relations protocol. In terms of the Ordnance Factories, certain management practices developed with the transition of the production process of munitions into a factory-orientated system in the immediate post-Crimean War era. For example, the theories of F.W. Taylor in America during the latter part of the nineteenth century and the development of scientific management, only synthesised existing piecemeal practices into a written and recorded body of knowledge.

Indeed, Braverman refers to the fact that:

"the use of experimental methods in the study of work did not begin with Taylor; in fact, the self-use of such methods by the craftsman is part of the very practice of a craft." (Braverman, 1998: 61)

Braverman considered that:

"the publication of management manuals, the discussions of the problems of management and the increasingly sophisticated approach taken in practice in the second half of the nineteenth century lend support to the conclusions of the historians of the scientific management movement that Taylor was the culmination of a pre-existing trend." (Braverman, 1998: 61-62)

To support his argument, Braverman quoted Urwick and Brech as follows:

"What Taylor did was not to invent something quite new, but to synthesise and present as a reasonable coherent whole ideas which had been germinating and gathering force in Great Britain and the United States throughout the nineteenth century. He gave to a disconnected series of initiatives and experiments a philosophy and a title." (Urwick and Brech, quoted by Braverman, 1998: 62)

Traditionally, economic history as a discipline has explored international, national and regional development in a historical form. Economic history attempts to analyse why certain nations or regions develop faster than others, or the causes of swings of the business cycle. For example, economic historians have attempted to explain whether there was a depression in the British economy from 1871 to 1895 (known controversially as the Great Depression) (Saul, 1985). Factors in this debate include the increase in industrialisation of France, Germany and America, which experienced a second industrial revolution. For the first time the British economy was suffering from intense competition, particularly in its staple industries.

Labour history has traditionally been recognised as a subdivision of economic history. Indeed, labour history has had a long relationship with orthodox economic history. However, labour history tends to represent the history of class conflict and systems of individual control. In relation to this thesis, which argues that the post-Crimean reforms of the Ordnance Factories and the onset of interchangeability, the work of Braverman proves useful. Braverman's *Labor and Monopoly Capital, The*

Degradation of Work in the Twentieth Century, first published in 1974, has by 1998 entered its twenty-fifty anniversary edition.

Braverman's thesis challenged the orthodox interpretation of work as it evolved into the technological age with the notion of 'deskilling', by the challenge that reskilling actually meant deskilling. Braverman is influenced by Marx and his critique encouraged:

"... a generation of historians stimulated by E.P. Thompson's *The Making of the English Working Class* (1964) to explore labor history from radically new perspectives drew heavily on Braverman in the 1970s. In sociology, an entire body of literature inspired by Braverman arose, now known familiarly as the labour process debate." (Braverman, 1998; new introduction by J.B. Foster, xiii)

Much research relating to labour history reflects the conflict of a growing urban industrialised working class together with a growing middle class of entrepreneurs and managers of the working environment. This is evident from the research of other distinguished labour historians, notably Hinton, Hobsbawm and Pollard.

Accounting history has been recognised for about a hundred years. Its impact in Britain is still somewhat marginal although its influence is growing. Orthodox economic historians have not fully considered the role of accounting as a tool of analysis within the broader field of economic history. Indeed, Pollard considered that the "practice of using accounts as direct aids to management was not one of the achievements of the British industrial revolution" (Pollard, 1965: 288). This was despite the earlier pioneering work of Roll (1930) into cost accounting systems employed at the Boulton and Watt Soho Factory at the turn of the nineteenth century.

Later research has tended to negate Pollard's viewpoint. The work of McKendrick (1970) again suggests that Wedgwood extensively used cost accounting techniques at his Pottery during the late eighteenth century. This later research has pointed to

the fact that accounts and accounting were management tools used in the British industrial revolution; for example, Stone (1973) explored an early English cost accounting system that existed at the Charlton Cotton Mills, Manchester in 1810. Boynes and Edwards (1995) again researched into the existence of the costing systems in the coal, iron and steel industries to 1900. In 1989, Edwards published an up to date review of recent knowledge and understanding of industrial cost accounting developments in Britain to 1830.

Business history in Britain has evolved since the early 1950s from company histories written by the companies themselves, via retired directors or senior managers who could be trusted with the Whig interpretation of their respective company histories. Most of these histories tended to be unsatisfactory relating no more than perhaps short biographies of important members within the evolution of the company. Such histories lacked appraisal or any analytical approach.

The development of business history in the USA over the last thirty years has tended to shift the emphasis away from company histories towards generic themes, notably through Chandler (1962, 1977, 1990). Chandler moved the focus of business history towards organisations, particularly through the corporate management revolution rather than through the traditional approach of appraising the historical significance of entrepreneurs. The perception of Chandler's research was through the emergence of a bureaucratic firm together with its managerial hierarchies. This is evident with factory production, particularly of the Federal Armories and the American railroad system. Both were influenced by contemporary reforms of the American military, particularly the Ordnance Department and the Corps of Engineers. The focus of Chandler's interpretation of business history was through technical change in the

nineteenth century, widening markets, mass consumer demand, which thrust the shift of production from craft to mass production. The growth of the demand for high volume production and distribution resulted in the growth of corporate managerial hierarchies to explore strategies lowering their transaction costs through absorbing more and more transactions into their own entrepreneurial organisations. Thus bureaucratic activity replaced market activity.

Management history is a relatively new concept within the wider field of economic and social history. Although the history of management exists within business history, there tends to be a lack of analysis between the business and the manager in the role and activity of management, for example the socio-economic origins, education and training of the manager. Recent research by Gourvish has begun to make an inroad into this void, particularly with his account of Mark Huish and the London and North Western Railway (Gourvish, 1972). A later paper by Gourvish examined the background of senior railway executive managers from 1850 to 1922 (Gourvish, 1973). Again, Gourvish has linked business and management history through his research into British railway history and its development from 1850 into a structure where there was a divorce of ownership from control. Gourvish commented that:

"By the 1850s, however, a measure of progress was clear. While British industry in general was centred on the family firm or partnership, companies such as the London and North Eastern Railway and, later, the North Eastern led the way in developing line and staff procedures, a delegation of authority to salaried managers, and a more comprehensive understanding of the complexities of accounting and costing in the modern business sense (Gourvish, 1972; Irving, 1976)." (Gourvish, 1980: 10)

However, more recent research by Brech (yet to be published), who has begun a study concerning the development of management in its historical context, has continued the

earlier remedy by Gourvish of linking business and management history into a more cohesive relationship.

The link between management history and accounting, business and labour history is more fully appreciated in the area of scientific management. Braverman argues that:

"The classical economists were the first to approach the problems of the organisation of labour within capitalist relations of production from a theoretical point of view. They may thus be called the first management experts, and their work was continued in the latter part of the Industrial Revolution by such men as Andrew Ure and Charles Babbage." (Braverman, 1998: 59)

Braverman suggested that:

"Between these men and the next step, the comprehensive formulation of management theory in the late nineteenth and early twentieth centuries, there lies a gap of more than half a century during which there was an enormous growth in the size of enterprises, the beginnings of the monopolistic organisation of industry, and the purposive and systematic application of science to production." (Braverman, 1998: 59)

In relation to the Ordnance Factories which it is argued in this thesis restructured into factory-orientated production centres within a decade after the termination of the Crimean War, the analogy between factory structure, hierarchical line and staff function, the establishment of work measurement and design is very apparent.

Braverman, in his original first edition, suggested that:

"The technical subordination of the worker to the uniform motion of the instruments of labour, and the peculiar composition of the working group, consists as it does of individuals of both sexes and all ages, gives rise to a barrack-like discipline, which is elaborated into a complete system in the factory and brings the previously mentioned labour of superintendence into its fullest development, thereby dividing workers into manual labourers and overseers, into the private soldiers and the NCOs of an industrial army." (Braverman, 1974: 549)

The new names associated with management history and who, perhaps, viewed the notion of management with a less jaundiced viewpoint as portrayed by Braverman,

are Pollard and Chandler. Pollard's research, as published in *The Genesis of Management*, explored the rise of the 'professional' manager as the individual entrepreneur in the early part of the British industrial revolution. Chandler's research explored a different phenomenon in the rise of the salaried professional manager in the context of an occupational grouping in America during the second industrial revolution.

Pollard, with his *Genesis of Modern Management*, written and published in the mid 1960s, "is still judged by many to be the most stimulating single text on the subject, and its analysis ranges much wider than is suggested by its title" (*The Guardian*, 24 November 1998). As part of his analysis, Pollard assessed the development of management in the Admiralty dockyards during the eighteenth century in an attempt to identify the emergence of a managerial class. *The Genesis of Modern Management* made an impressive sally into this unknown area over thirty years ago but this pioneering work has not been further developed.

However, the work of Chandler (1977, 1990) has pioneered the historical interest in the origins and development of the management revolution mainly as it evolved in America. The *Visible Hand* (1977) was a study of the development of the management revolution in America during the nineteenth century. Chandler's research focuses on the development of the professional manager as the corporate development moved towards the separation of ownership from control. This put the role of the professional salaried manager in a new focus. Before World War II, Britain's managers had much less professional status when compared to the American experience. Chandler's *Visible Hand* highlights the importance of the American military (the Ordnance Department and Corps of Engineers) and the role of the Federal Armories at Springfield and Harper's Ferry in this development as previously mentioned.

Chandler's later work, *Scale and Scope* (1990), was based on a historical comparison of the new forms of capitalism as manifest in the United States and Europe during the second half of the nineteenth century. Chandler refers to the advanced development of American and German entrepreneurship and management structures in the second half of the nineteenth century, compared to the backwardness of British entrepreneurship and management. According to Chandler, British entrepreneurs failed to make the three-pronged investment into marketing, manufacturing and management, whereas both American and German entrepreneurs had exploited this much earlier (Chandler, 1994: 235).

Chandler (1977) and his contemporaries (Payne, 1967; Coleman, 1973) have commented on the failure of British capitalism and entrepreneurship during the nineteenth century and these will be touched on in this thesis. However, the emergence of the Ordnance Factories from 1856 onwards lay outside the parameters of the failure of British private capitalism as they were state-owned institutions. This may indeed have played a major part in their industrial and managerial success to 1925.

The emphasis of management of the Ordnance Factories is also important because the contemporary engineering / metal industry in Britain reflected small-scale production capabilities and apparent entrepreneurial failure (Chandler, 1996: 275-83).

Chandler states that:

"Although there were few entrepreneurial opportunities within Britain in the oil and meat processing industries, there were many in mass-produced standardised light machinery, electrical equipment, chemicals and metals. In these industries British entrepreneurs failed to grasp the opportunities in the new technologies that had opened up precisely because they failed to make the necessary inter-related, three-pronged investment in production, marketing and management. These opportunities within Britain were seized instead by Germans and Americans." (Chandler, 1996: 27)

It is part of the argument of this thesis that the rapid development of the original government workshops (under the control of the Board of Ordnance prior to 1854) into a comprehensive factory system from 1858 is in marked contrast to the engineering / metal industry in the private sector and an instance where Britain did grasp the new systems noted by Chandler. However, despite the success of the Ordnance Factories from 1858, this success has not attracted the research interest from historians that it deserves.

Previous research in the history of the public sector

Before proceeding to the research methods to be used in this thesis, it is perhaps pertinent to illuminate the concept of history, particularly in terms of accounting and business history, and criticisms of the existing state of play.

Other areas of the public sector, particularly central government departments, have similarly not attracted the attention of historians. In particular, and contemporary with the Ordnance Factories, are the naval dockyards. Indeed, the reforms of the naval dockyards from 1834 by Sir James Graham, First Lord of the Admiralty, became the model for the reforms of the Ordnance Factories from the mid-nineteenth century. Ashworth's paper of 1969 is an example of how economic history can relate to a public sector organisation. Ashworth in particular wrote on the economic impact of the naval dockyards in the late nineteenth century (1969: 491-525).

Hobsbawm briefly mentioned the role of the ordnance factories, suggesting that "the pioneering role of the government's own establishments must not be forgotten. During the Napoleonic Wars they anticipated, amongst other things, conveyor belts and the canning industry" (Hobsbawm, 1974: 50).

Again, Hobsbawm refers to some of the leading players in the industrial revolution who gained their experiences in the government's naval and ordnance establishments. For example, men like:

"Henry Cort, who revolutionised iron manufacture, began in the 1760s as a Navy agent, anxious to improve the quality of the British product in connection with the supply of iron to the Navy. Henry Maudsley, the pioneer of machine-tools, began his career in the Woolwich Arsenal and his fortunes (like those of the great engineer, Marc Isambard Brunel, formerly of the French navy) remained closely bound up with naval contracts." (Hobsbawm, 1974: 50)

Marc Brunel, together with Henry Maudsley and Samuel Bentham, also pioneered what Cooper has called "the Portsmouth System of Manufacture", in the production of pulley blocks for the Royal Navy at Portsmouth Dockyard from 1805 (Cooper, 1984).

One history of the Royal Arsenal at Woolwich has been written, in 1963, compiled by a senior military officer and former deputy Master General of the Ordnance (MGO) Brigadier O.F.S. Hogg. Regimental and military histories are often written in the same style as traditional business histories as defined previously by Ferguson, and Hogg's history of the Royal Arsenal exemplifies this. Also the multi-volume, unpublished *History of the Ministry of Munitions* is written in a similar vein. Ashworth (1969) wrote a paper on the late Victorian naval administration. Here, Ashworth was very careful to write his paper as an economic history rather than as a naval or technological paper.

Another criticism of accounting, business and labour historians is their lack of interest in the public sector generally, and in the civil service and government departments in particular. With particular regard to accounting history, Anderson reinforces this criticism suggesting that "few scholars have dedicated themselves to

management accounting and even fewer have looked into government accounting, central or local" (1994: 67).

Both Loft (1986, 1988, 1994) and Marriner (1994) have explored the area of accountancy and the First World War. Yet they leave gaps in their research as to the origins of the reforms of the Ministry of Munitions. Loft in particular tends to overplay the role of professional accountant in these reforms. Again, some of these gaps exposed by the research undertaken by Marriner and Loft are explored in this thesis, which hopes to give an adequate explanation to the origins of the reforms of the Ministry of Munitions.

A background to the Ordnance Factories

A more comprehensive history of the British Ordnance Factories is given in Chapter 3. Suffice to state by way of introduction that the Ordnance Factories, or Government Manufacturing Departments as they were known until 1887, had existed since the late eighteenth century, the Royal Laboratory being formed in 1696 although the origins of the Arsenal at Woolwich Warren can be traced back to the reign of Elizabeth I (1558-1603). From 1560 the Board of Ordnance had storehouses located on Woolwich Warren and in 1588 guns were erected on Woolwich Warren as a temporary measure for defence of the Thames (SUPP 5/1037). According to Hogg: "The Royal Arsenal can be considered to have begun on the 13th June 1667 when Prince Rupert was commissioned by Charles II to fortify Woolwich Warren as a defence against the Dutch fleet" (SUPP 5/1037). The origins of the Royal Gunpowder Factory at Waltham Abbey can also trace its origins to Tudor times.

The role of the Ordnance Factories was to manufacture and supply munitions

and procurement for the regular Army and Royal Navy. Although the Royal Navy had its own ordnance factories, cannon, gun carriages, guns and ammunition were supplied to the Admiralty by the Royal Brass Foundry and then from 1860 by the Gun Factory at Woolwich.

An examination of the accounting-driven management reforms of the Ordnance Factories is the key to understanding the development of public sector management generally in his historical context. Also, in particular such a study answers questions originally set through the previous research conducted by Marriner and Loft.

A number of major reforms within the War Office and the British Army from 1855 onwards were as a result of the experiences of the Crimean War and the close relationship formed between the (unusually) allied British and French armies reflected in contracts and tenders for the procurement of military supplies and in French rifled artillery which proved so successful in the breaching of the Redan at the siege of Sevastopol.

The superiority of the French equipment had a considerable history and must be seen in terms of the French enlightenment in the eighteenth century and as it was manifested in the American War of Independence. This included the standardisation of artillery and arms uniformity in general. Also the French (as were the Prussians) were superior in relation to military education in the nineteenth century, as illustrated in the Ecole Polytechnique.

Smith argues that:

"Since the Revolutionary War, French artillerists and engineers had exercised a pervasive influence on the United States Army. Through them, engineering treatises, testing procedures, arms designs and educational techniques had made their way to the American shores and were assimilated by native officers. Indeed, whenever the United States needed to revise and improve its military program, it looked primarily

to the 'French system' for its appropriate models. This practice continued until well into the 1840s." (Smith, 1987: 44-5)

The transition of the Ordnance Factories after 1856 into factory orientated production centres, together with the development of line and staff functions, occurred within a decade. The reasons for this transition are complex, but the failure of the British land army in the Crimean War is a major cause of reform, as has been stated. However, the reason for reform can go back earlier to the Great Exhibition at Crystal Palace in 1851. Here, American gunsmiths displayed their small arms constructed by the process of interchangeability.

The resulting Board of Ordnance Commission visitation to the American armories (including the Federal Armories of Springfield and Harper's Ferry) resulted in the construction of the Royal Small Arms Factory in 1858, followed by the Shell and Paper Factory at the Royal Laboratory and by the Royal Gun Factory, both on the Royal Arsenal site at Woolwich.

A contemporary writer, the locomotive engineer John Fernie, praised the manufacture of duplicate machines in wood and iron at the new Enfield Rifle Factory in a paper written for the Institution of Civil Engineers in 1863 (*Institution of Civil Engineers Minutes of Proceedings*, vol.22, 1862-63: 604). Fernie's application of this observation was to introduce interchangeability into railway locomotive construction. This was not unusual: the manufacture of cannon included the casting in a mould of two halves of a cannon, then boring the barrel. This process or skill was equally adaptable to the casting and boring of cylinders for both static steam pumps and locomotives.

The design and construction of the post-1856 Ordnance Factories was carried out by James Alexander Cameron Hay, who spent all his career from apprentice

draughtsman to civil engineer in the employment of the War Office. These themes and the personalities behind the reforms are further explored in Chapter 5.

Research approaches

Anderson has identified three research methodologies appropriate to accounting, business and financial history: (i) traditional, (ii) critical and (iii) positive (1994: 70-1):

- i) The traditional school relates towards describing and interpreting the past. It comprises of research "which has generated data regarding different forms of accounting and accounting practice over time" (Anderson, 1994: 68).
- ii) The critical perspective, according to Anderson, is a major recent development in the study of accounting history and attempts "to place the subject more firmly in its historical context" (Anderson, 1994: 72). The main thrust of the critical perspective approach is that accounting (nor management) should not be seen as a neutral or technical process but it should be perceived in a wider, more complex process within social, political, economic, technological and organisational factors, which can be in direct conflict with one another (Anderson, 1994: 72).
- iii) The positive approach views "the objective of theory as explaining and predicting accounting practice" (Anderson, 1994: 75). Anderson suggests that much reliance for this approach is placed on economic theories "which are largely drawn from the neo-classical perspective" (Anderson, 1994: 75). Anderson also suggests that "the importance of this is clear, given the (sometimes harsh) criticism of some traditional research as fact-finding antiquarianism. In addition, the problems addressed are likely to be of contemporary relevance"

(Anderson, 1994: 75).

To test the hypothesis of this research, the methodology used will be a critical perspective of the British ordnance establishments from 1855 to 1925. The critical perspective of this research is to place the reforms of the Ordnance Factories more firmly in their "historical context" (Anderson, 1994: 72). Although Anderson was writing about research methods in accounting history, these adapt well to management history for, as Anderson suggests:

"The critical perspective is a major recent development in the study of accounting [and management] history which attempts to place the subject more firmly in its historical context." (Anderson, 1994: 72-3)

This is an important issue for a study of the management structures of the British ordnance establishments. Advocates of critical perspectives of history have attempted to use theories of a power-knowledge relationship, notably by Michael Foucault (1970, 1972, 1977, 1980). According to Anderson, Foucault:

"... introduces a notion of a discourse of accounting which is 'a language expressed in terms of accounting that, as it changes through time, enables us to see, within accounting, different phenomena, and by seeing them, controlling them'." (Anderson, 1994: 73; quoting Napier, 1989: 245)

The research of Hoskin and Macve (1986, 1988, 1994, 1997) on the American development of accounting through the reforms of the Springfield Armory is important in the context of this thesis. The origins of interchangeability at the Royal Small Arms Factory, Enfield was influenced by the Springfield Federal Armory, as will be stated later. In addition, although there was no exact equivalent military academy in Britain parallel to West Point, the Royal Military Academy at Woolwich was nearest to a West Point model. The graduates from Woolwich became the soldier-technologists in the British Army, but their influence was not so great in Britain as was the counter-

part soldier-technologist in America, particularly the relationship between the US Corps of Engineers and the American railroad system (O'Connell, 1987; Hoskin and Macve, 1997).

During the period of the British industrial revolution, the application of accounting both as a commercial and management tool, was limited. Its use lay in very rudimentary forms of cost control and in financial stewardship. Accounting was used as a tool which "... aimed to conserve loss rather than maximise gain. It did not operate as part of something one might call 'management'" (Hoskin and Macve, 1994: 7). Chandler emphasises this and argues that a trend in British entrepreneurship was "accounting for failure" (1996: 248). There are numerous reasons why British capitalism did not develop as in contemporary America and Europe. The "answer to this historical question is enormously complex" (Chandler, 1996: 284), but it is worth noting at this stage that the structure of British capitalism during the nineteenth century reflected family capitalism and that entrepreneurs were producing successfully to a localised market which demanded craft orientated goods rather than national markets which required economies of scale and production (Payne, 1967; see also Chandler, 1996: 234, 294).

The transition to modern corporate structures occurred first of all in America. Chandler defines this through specific characteristics: "It contains many distinct units and is managed by a hierarchy of salaried executives" (1977: 1). Chandler identifies these beginnings of modern business thus: "Single-unit management had its genesis in the United States at the Springfield Armory" (1977: 75; see also Hoskin and Macve, 1994: 80).

Although the soldier-technologist concept as it emerged in America was very

influential in the development of modern corporate structures, the soldier-technologist concept as it developed in Britain was less significant in the private sector. Nevertheless, the scientific corps of the British Army (the Royal Artillery and Royal Engineers) were influential in both the British and Indian Ordnance Factories and indeed more generally in the Indian Public Works Department. The influence of the Royal Engineers permeates into the railways both in Britain and in India.

The managerial reforms of the British Ordnance Factories occurred in the immediate post-Crimean War era from 1856. The outcome of the Crimean War itself was the fulcrum of reform, as was previously noted. But of equal importance was the prevailing doctrine of Victorian liberalism (Ashworth, 1969). This point is further explored later in this chapter.

Historiography and research sources

The initial enquiry into this research included a historiographical search. It has been suggested that the historiography of the Ordnance Factories generally is poor and reference has already been made to Hogg (1963). Trebilcock wrote on war and industrial mobilisation two decades ago (1975) and his earlier papers (1966, 1969) corresponded to rearmament and the government relationship to the cordite firms (1968). However, the emphasis of Trebilcock's research was more with the private sector rather than the Ordnance Factories. Along with Adams (1978) and Loft (1994), Trebilcock's writings suggest that the Ordnance Factories were less efficient than the corresponding private sector apparently because they were public sector organisations.

Trebilcock describes the second Anglo-Boer War (1899-1902) as the last of the *laissez-faire* wars. He stated that:

"The restrictive factor was the state of the [Royal] Arsenal's equipment; it was not fully up to standard and its forging capacity was markedly deficient. The fact that the Royal Gun Factory did not have a drastically busy war and made few heavy guns - while orders were heaped on the trade and the army in the field cried out for heavy guns - is explained by bottlenecks within the state factories." (Trebilcock, 1975: 147)

The traditional role and purpose of the public sector ordnance factories was:

to carry the burden of munitions demand only at the commencement of a war and until such time as the private sector shifted into higher gear." (Trebilcock, 1975: 147)

The ratcheting-up policy of the private sector failed partly because of the concept of *laissez-faire* of the private sector. Unlike the state Ordnance Factories, the private sector rarely maintained idle though expensive reserve production lines (mothballed until a demand by war made them operational). Trebilcock argues that the military authorities who, reporting to the post-1902 'post mortem' enquiries of the second Anglo-Boer War "were loath to admit that their factories - seen as army 'commands' - had shared in the production problems of the private trade." Both Armstrong's Elswick factory and at Vickers, government inspectors found these private munitions factories in disarray, "clogged with work, expanding haphazardly in a desperate attempt to provide manufacturing space" (Trebilcock, 1975: 146). Despite the universal munitions production problems of 1900 (to be repeated again in 1914), the state-owned Ordnance Factories did fare better in 1900 than did their private sector counterparts. Although not totally efficient, the ratchet effect was better met at the Ordnance Factories than at either Armstrong's or Vickers. Trebilcock did not mention that the post mortem report of 1906, the Murray Committee Report (Cd 3626) recommended the removal of the reserve production facilities of the Ordnance Factories. This recommendation was initiated by the Master General of Ordnance

(MGO), Sir Frederick Hadden, between 1910 and 1914 and was a major contributory factor towards the far larger shell scandal of 1914-15.

It must also be remembered that the large private munitions factories, notably Armstrong Whitworth and Vickers, produced for the international arms market, a market more lucrative perhaps than short-term War Office and Admiralty contracts. Indeed, Warren has suggested that the privatised "armament firms were pioneer multinationals" (Warren, 1989: xiii). The Ordnance Factories only produced munitions for the Regular and Reserve Army, the Admiralty, the Indian Army, the Egyptian Army and British Colonial Armies. There was no requisitioning of munitions destined for the international arms market during the second Anglo-Boer War - this did happen however in 1914, under emergency legislation (Defence of the Realm Act).

In relation to accounting history many of the published works tend to be at a micro-level only and relate to the major institutions. Indeed, appreciation of the historiography of accounting history is critical of these house histories but Anderson is more complimentary of Edgar Jones and his evolutionary history of Ernst and Whinney (Jones, 1981). Ashworth achieved a similar result with his paper on the economic impact of the naval dockyards in the late nineteenth century (1969).

A useful exercise is to pursue primary source data previously explored by earlier researchers. It is here that there may be a conflict between different studies of researchers in the same broad discipline. Carnegie and Napier suggest that:

"The important function of documenting accounting's past was carried out not just by self-identified accounting historians. Economic and social historians frequently document and use accounting materials, though their interest in these is often motivated by questions from their own discipline rather than specifically accounting-related issues. This has often allowed subsequent accounting historians to revisit and reinterpret archives that had been fully exploited by earlier generations. For example, both Fleischman and his colleagues (Fleischman and

Parker, 1991; Fleischman and Tyson, 1993) and Edwards and his collaborators (Edwards, 1989b; Edwards and Newall, 1991) have reviewed much of the archival evidence from which the economic historian Sydney Pollard (1965: 248) concluded that 'The practice of using accounts as direct aids to management was not one of the achievements of the British industrial revolution'. The more recent research draws different conclusions: 'Cost accounting practices during the industrial revolution were far more developed and widely utilised than many renowned scholars have believed'." (Fleischman and Tyson, 1993: 515; Carnegie and Napier, 1996: 14)

Anderson (1994: 81-2) refers to difficulties in relation to accounting history, which include:

- "a) The physical location of source material, involving time and cost;
- b) The assessment as to how typical the sample chosen is of the total population;
- c) The way in which to avoid unnecessary bias, to produce an impartial view;
- d) To recall that documentation of past events will, in all probability, be incomplete." (1994: 81-2)

Although Anderson was referring more to accounting history, these practical difficulties are also relevant to management history and were experienced in the compilation of this thesis.

Records exist of the Ordnance Factories since the mid nineteenth century. The accounting records and other documents are preserved and centralised in the Public Record Office at Kew. In relation to the public sector, the records of the Ordnance Factories are perhaps more complete and numerous than the corresponding private sector business organisations, thus their accessibility and centralised physical location are more efficiently retrievable in time and cost and perhaps more complete than a contemporary private sector organisation. However, there are gaps in the primary source data and this is due to war damage both in the First and Second World Wars.

For example, the Royal Arsenal, Woolwich and the Royal Gunpowder Factory, Waltham Abbey were targeted by zeppelins in 1915, gotha bombers in 1917, the Luftwaffe in 1940-2 and by V1 and V2 rockets in 1944 and 1945.

Bearing this in mind, this thesis has followed the consideration of Carnegie and Napier, who suggest that any research into the accounting and management history of the public sector should consider the following areas as being relevant for study in as far as they relate to the central arguments of this thesis:

- "a) a description and analysis of surviving accounting records [This also includes the management records of the Ordnance Factories, including Parliamentary Papers, official reports and the original internal papers of the Ordnance Factories];
- b) the examination of the literature surrounding public accounts;
- c) a search for the various motivations, political and otherwise, which shaped the public accountability systems;
- d) a review of the history of ideas concerning public accountability." (1996: 26)

As this thesis is concerned with management, which includes the public accountability of the Ordnance Factories, these areas identified by Carnegie and Napier have been extended to reflect this. Other supporting primary source data has been interpreted along with the accounts of the Ordnance Factories, which include:

- British Parliamentary papers in relation to this study.
- Various committees of inquiry and Public Accounts Committee (PAC) records.
- War Office papers relating directly or indirectly to the Ordnance Factories and, from 1915, Ministry of Munitions papers.
- Various War Office directories, the Army and Navy lists, the official though unpublished and undated twelve-volume *History of the Ministry of Munitions*.
- Various contemporary newspapers.

- A reassessment of the literature. Most concerns the First World War era, notably Hinton (1973) and the first Shop Stewards' Movement (Loft, 1994; Marriner, 1994).

However, Ashton, in an earlier work, published a volume in the official series, *The History of the Second World War* (1953). His volume was on contracts and finance. Ashton, however, concentrated on the decade after the First World War up to 1945. He made little mention of the Ministry of Munitions and no mention was made of the pre-1915 Ordnance Factories. Where Ashton does mention the Ministry of Munitions, in relation to similarities in the legal niceties of arms contracts, that is the clause to terminate by giving three months' notice, after the contract had run for one year (p60); the costing method used to price contracts, i.e. the post-costing, plus a rate of profit prescribed by the government, subject to Excess Profit Tax (EPT) (p67), and the origins of the Technical Costs Section (p70 - footnote). This section "was originally developed in the Gun Ammunition Department of the Ministry of Munitions in 1915... It was later used for many other classes of stores purchased by the Ministry ... and was transferred to the Admiralty in 1920 when the purchasing function of the Ministry of Munitions ceased" (Ashton, 1953: 70 - footnote).

When assessing what occurred in the contemporary British public sector, one should be aware that complete contemporary records are rare, which contrasts with the archive material that exists for the American War Department.

Compared to the private sector, little has been written or researched on Victorian management in the public sector.

There is a need for research to be conducted to explain how the components of business history interface with each other. The current philosophy of both account-

ing and labour historians is to research in components without understanding the other areas of business reform.

Limitations of earlier research, especially in relation to costing and accounting

In comparing the American development of cost accounting with the British experience, Hoskin and Macve consider that, where there is evidence of the use of costing in the eighteenth and nineteenth centuries in Britain, its development was not utilised "to co-ordinate production, control costs and maximise productivity on a regular basis" (1994: 80). Their thesis depends on the American development within the US Army. Previous research reveals an apparent lack of interface of management issues of accounting, production process control and industrial relations reforms.

Until recently the history of cost accounting before the mid 1880s was not based on any published contemporary texts, which may indeed have existed, nor have sufficient primary source costing records survived. However, cost accounting histories over the last fifty years tend to rely on published works of British theorists at the time, notably Fells (1887), Garcke (1887), Lisle (1899) and Pixley (1897). These theorists suggest that the practical application for decision-making through costing developed from America through the scientific management movement under the innovation of Frederick Taylor. Richard Brown, a chartered accountant from Edinburgh, made an attempt in 1905 at publishing a general history of the accounting profession, however the completed monograph of some 300 pages failed to identify industrial cost accounting in its entirety (Brown, 1905; Jones, 1981: 80). Brown related the history of accountants as they contemporarily existed. His monograph is very much a personal narrative of contemporary accountants and traditional accounting procedures which

is no more than was produced by Pixley (1897) and Lisle (1899). As traditional accountants did not concern themselves with cost accounting, traditional accounting commentators, including Brown, did not broach the subject.

The accounting and production reforms within the post-1855 Ordnance Factories led to other complementary reforms including scientific management. Similar but rather limited reforms in the contemporary private sector originated more from the practical man approach. Such reforms were not transferable to other organisations. Individual organisations used their own systems. These were created on a rule of thumb basis, particularly in the private engineering sector, which was predominantly craft-orientated, reflecting demarcation and controlled rigidly by powerful trade union interest, notably the Amalgamated Society of Engineers (ASE).

Urwick and Brech (1953, vol.2: 72-87) gave an example of the non-transferable skills in their assessment of J. Slater Lewis (1852-1901). Quoting from Slater Lewis, Urwick and Brech stated:

"For the mere purposes of commercial book-keeping, it matters, indeed, little in the way the general and shop establishment charges are dealt with, so long as they are eventually paid out of the profits made in the work ... it matters little whether they appear in the books as chargeable to general revenue, or are allocated to several items of work in progress in the shops ..." (1953: 78)

This localisation of systems had been inherited from the experience of cost accounting in the eighteenth century where it existed. Much has been written on the influence of J.M. Fells and E. Garcke in their *Factory Accounts, their Principles and Practices*, first published in 1887. The date of this first edition may have influenced Solomons (1957) to date "the costing renaissance" from the mid-1880s. However, *Factory Accounts* from its first edition in 1887 to its sixth edition in 1910, gave "only the briefest reference to cost accounting", a point made by Jones (1981: 114).

Indeed, *Factory Accounts* followed other trends in the published text from the later nineteenth century in its legalistic approach to the practicalities of accounting. Only the seventh edition published in 1922 gave a wider experience to cost accounting, due no doubt to the experiences of accounting and the First World War and in particular to the cost accounting experiment in the Army from 1917.

However, despite the lack of texts on the subject of cost accountancy, there is evidence to suggest that it was practised in the eighteenth and nineteenth centuries. Reference has already been made to the costing systems of Boulton and Watt (Roll, 1930) and to Wedgwood (McKendrick, 1970). Cost accountancy may not have been the prerogative of accountants but rather engineers or entrepreneurs, "men closest to the problems and particularly anxious to improve their organisation and output" (Jones, 1981: 115).

An example of this can be seen from the contemporary railway industry, although it came rather later and can be assumed to be a twentieth-century development. The North Eastern Railway (NER) managers had until the turn of the twentieth century relied on competition for its freight traffic on roads and coastal shipping, "to govern the level of their freight rates, with marginal and essentially intuitive adjustments for specific commodities and distances" (Irving, 1976: 123; Jones, 1981: 115).

The main user of the NER freight trains, the farmers within that region, complained in the 1880s that imported foodstuffs were conveyed more cheaply by the NER than their home-grown produce. In its initial defence, the NER replied to the farmers' complaints that imported foodstuffs were collected from the ports of disembarkation in bulk and that as a consequence they were easier to handle. The NER management possessed little statistical evidence either to confirm their defence, or to

prove the farmers right. By the turn of the twentieth century, however, the NER pioneered the systematic use of ton-per-mile statistics for the first time in Britain, but it was only in 1914 that the system, developed in order to analyse the whole question of undue preference which had caused friction between the NER, the port authorities and the farmers, began to be resolved. The system eventually allowed for average rail freight for specific lines to be calculated, the figures then used to determine appropriate rates. The system eventually led to greater flexibility in charges, including the establishment of special rates which superseded a strict price charge which varied directly with distance (Irving, 1976: 123-5; Jones, 1981: 115-6).

It must be remembered that this system, adopted by the NER, only occurred in 1900 and was not fully operational until 1914 when other railway companies eventually followed suit. In 1849 the Great Western Railway (GWR) invited a public accountant William Deloitte to inspect the company's books, a prospect not well received by the board of the GWR. The purpose of Deloitte's inspection was to comply with the legal requirements of the 1845 Companies Clauses Consolidation Act and not for the efficiency of costing and comparing or laying down tariffs and fares (Jones, 1981: 52).

The third substantial component of this chapter deals with the economic, social and industrial contexts of the period from 1855 to 1925.

Structure of British capitalism, 1855 to 1914

Before concluding this first chapter it is important at this stage to give an overview of the structures of British capitalism from 1855 to 1914, as compared to America. Having said this, by the late nineteenth century competition from Germany

and France also overtook Britain in industrial supremacy. Much of the German co-operative management capitalism, as did the United States, employed:

"... salaried managers with little or no equity in the enterprises for they worked... German entrepreneurs were often the first in Europe to make the three-pronged investment in manufacturing, marketing and management." (Chandler, 1996: 393)

This goes some way to explain why British industrialists failed to make any significant advances through costing techniques up to 1914. Neither did British industrialists, entrepreneurs, senior managers or indeed the emerging professional accountants enquire about the major impact of management reforms taking place in America, in particular du Pont's asset accounting principles, cost accounting or scientific management.

Payne has elaborated on the major differences between American and British corporate growth from 1870 to 1914. Even the larger companies in Britain were still ossified in family capitalism. Payne suggests that:

"Among such enterprises some, like Huntley and Palmer, Crosse and Blackwell, J. and J. Colman, Pilkington Brothers and Harland and Wolff, were extremely efficient and became very large, despite the fact that they were entirely private on the very eve of the First World War." (Payne, 1967: 526)

Although the success of Huntley and Palmer, Crosse and Blackwell and J. and J. Colman were "impressive in the British context, the scale of enterprises in the food sector in the United States was much bigger" (Payne, 1967: 526, footnote 3).

The reasons for the lack of interest in cost accounting in Britain at the eve of the First World War has much to do with the differences in size and corporate structure in Britain as compared to America. The lack of interest in the post-1918 era in Britain may be due to the retrenchment of British industrial structure and practice enforced through legislation (Restoration of Pre-War Practices Act 1919).

Payne suggests that the growth of the American corporate structure as compared to the British corporate structure was due to the following reasons:

- The growth of urbanisation in America and the completion of a nationwide railroad network.
- The acceptance by the American market of a mass-produced standard-sized product.
- The American skill at product differentiation.
- The use in America of tariff protection.

By contrast, British corporate growth was marked quite differently by the following reasons:

- The ossification of the family firm. Private companies were not legally recognised in Britain until 1907.
- Most limited company ordinary shares were in the hands of the family.
- The British consumer preference for craft manufactured and individual characterised goods. This tended to create a culture resistant to encompassing new technology and the mass production techniques. An example of this relates to Sir Marc Brunel and his machinery designed to manufacture in 1812 Army footwear by mass production. The idea was never seriously considered by the British footwear industry for ninety years (Cooper, 1984: 255).
- A local or regional market demand required specialised goods. This negated any attempt towards diversification and discouraged investment in new production lines.
- The British entrepreneurial characteristic of independence and self-sufficiency.
- This was propagated by a belief in "the expediency of *laissez-faire*" (Payne,

1967: 526). The writings of men such as Samuel Smiles reinforced this culture.

The structure of British capitalism from 1855 to 1914 must be seen in the context of the political and economic doctrine of *laissez-faire*. It was in this period of economic liberalism that the Ordnance Factories flourished. The rationale of *laissez-faire* and its influence on the reform of the Ordnance Factories is given in more detail in Chapter 3.

Overview of subsequent chapters

In concluding this chapter an overview of subsequent chapters is now given.

Chapter 2 will focus on the growth of professional status in relation to the professional manager generally. A more in-depth examination will explore the role and growth of the soldier-technologist as a manager from the experience of the US Army resulting from the reforms of West Point Military Academy from 1819. The results of these reforms permeated into the US Army Ordnance Department and the Corps of Engineers. This, according to Chandler's thesis, resulted in the growth of modern business organisations, particularly with the development of the Springfield Federal Armory and the Corps of Engineers' involvement with the American railroad companies. This influence was reflected in the reforms of the British Ordnance Factories from 1855 onwards.

Chapter 3 explains the overall reforms of a reconstituted War Office from 1855, including the creation of the Accountant General's Department in its relation with the government manufacturing departments. A brief description is given of their overall history, status and purpose. Their existence and role in the era of classical

Victorian liberalism and the parsimonious treatment from the Treasury created the impetus to be successful and competitive. A survey of Parliamentary accounting in relation to the Army will also be given.

Chapter 4 introduces the first concept within the confines of this thesis, arguing that the cost and accounting systems and method in the nineteenth century may have been more advanced than the corresponding private sector. This development reinforced the concept of interchangeability and scientific management principles employed at the Ordnance Factories from 1862 onwards. In particular the case of the Elswick Ordnance Company and the production under contract of the Armstrong gun is considered. The personalities involved are also considered. Reforms undertaken at the Ordnance Factory in the 1860s only began to emerge in the Ministry of Munitions from 1917. By 1914 the Army and the Ordnance Factories were displaying to the public an aura of efficiency and economy.

Chapter 5 continues the themes set by chapters 2, 3 and 4, by tracing the origins of production by interchangeability from America and its introduction into the Royal Small Arms Factory at Enfield. This system also permeated into the Royal Arsenal, Woolwich and spawned the complementary functions of scientific management and labour relations in a relatively short space of time. This is despite the failure of the private engineering sector to be equally successful with similar production methods until the First World War.

Chapter 6 further explores the growth of a 'professional' management system within the Ordnance Factories and the development of employee relations including evidence of the evolution of 'scientific management'. The origins of piecework systems and their management are explored. Evidence would suggest that a premium

bonus system, very similar but prior to the Hasley system, operated in the 1880s. It was confirmed by the Murray Report (Cd 3626, 1907) that the Rowan premium piece-rate system was in use at the Royal Gun Factory at Woolwich just prior to the First World War.

The management structures of the nineteenth century Ordnance Factories are examined and critically assessed. Particular detail is given to the evidence of Lewis W. Engelbach, Principal Clerk to the Director of Artillery and Stores at the Royal Arsenal, Woolwich (the clearing house of management of the government factories) and of James McGee, manager of the Enfield Rifle Factory. Both gave evidence to the Morley Committee (C 5116: 1887).

Chapter 7 considers the causes for the Morley Inquiry, its recommendations and how these were implemented, particularly with the centralisation of the executive management function and the line of management. Within this chapter, evidence is given regarding the model employer ethos of the Ordnance Factories and the introduction of a 48-hour week to all government employees in 1894. Evidence suggests that this relates to the growth of scientific management efficiency systems, due in part to the recognition of a rational labour utilisation process. That this occurred at the latter end of the debated, so-called Great Depression tends to support the evidence so given (Hobsbawm, 1979: 356).

Chapter 8 assesses the evidence to suggest that the Ministry of Munitions appeared to rediscover the original pre-1914 reforms of the Ordnance Factories and to call them their own. This is despite the intrusion of professional accountants, entrepreneurs and industrialists from the private sector, who were appointed as temporary civil servants at the Ministry of Munitions.

There is a marked lineage from the nineteenth century Ordnance Factories through to the cost accounting experiment within the British Army from 1919 to 1925. The apparent reforms within the Ministry of Munitions were only temporary.

Chapter 9 addresses the contribution of this thesis to the advancement of our understanding of public sector management generally from the mid-nineteenth century to the immediate post-1918 period. Areas are identified where future research may be directed in order to achieve a greater understanding of management in the nineteenth century generally.

Summary

The evidence produced in this thesis is to prosecute the argument that there was an emerging professional management ethos from the Ordnance Factories from the mid-nineteenth century which was more sophisticated than the contemporary private sector.

In concluding this first chapter, the reforms of the Ordnance Factories from 1855 to 1925 occurred when the boundaries of Victorian economic liberalism were being challenged and changed. As the nineteenth century progressed, the electorate grew. Both Army and Navy technology expanded although the prevailing rationale of democracy and liberalism prevailed. On the one hand Britain deployed a small regular army to police an Empire, which heavily relied on locally recruited dominion and colonial troops, as well as the Indian Army. Alternatively, there was the perceived threat from the major central powers. To combat this threat, the Navy rapidly expanded in technological strength from the 1880s onwards. Much of the new weapons technology for a growing class of iron-clad warships were manufactured at

the Royal Gun Factory, Woolwich.

From 1855 to 1914, the major expenditure of Victorian governments was on defence. Due to the political doctrine of democracy and liberalism and the mistrust of defence expenditure *per se* by the Victorian taxpayer and Member of Parliament, the audit and control of defence budgets was far tighter than other spending department budgets. It is in this context that the reforms of the Ordnance Factories must be examined.

The appendix to this chapter is a time chart showing the reforms of the Ordnance Factories from 1855 to 1925 and names the personalities involved in these reforms.

Flow chart of the reforms of the Ordnance Factories, 1855 to 1925

1855: Crimean War	War Office created. Government manufacturing departments came under the War Office Board of Ordnance visitation to US federal and private armories.
1855	Royal Carriage Department introduces pieceworking.
1855	Office of Master General of Ordnance abolished.
1858 (Indian Mutiny) 1857-58	Royal Small Arms Factory Enfield, interchangeability (American system of manufacture). Machinery tools and expertise loaned from the Springfield Federal Armory.
1858	Internal War Office committee on the overspent budget on the rebuilding of the Royal Arsenal, Woolwich.
1862	The recommendations of this committee influenced the procedure of charging depreciation on buildings and capital assets.
1858-1862	Development of the Armstrong gun. One third of contract given to Elswick Ordnance Company, Molesworth Committee 1862, Elswick overcharging for an inferior but higher priced gun than was manufactured at Woolwich. Whiffin, Assistant Accountant General, initiates a costing system under John Anderson, Inspector of Machinery, and J.C. Hurst, a civil servant. Elswick contract terminated.
1858	Royal Gun Factories created from the original Royal Brass Foundries. Armstrong gun manufactured through interchangeability pioneered by the gun factory manager, Robert Fraser.
1864	Hurst introduces DEB into Woolwich.
1879	Reorganisation of clerical establishment mechanical writers identified as trained engineers.
1887	Morley Report. Evidence of James McGee, manager at Enfield, Hurst, chief auditor and accountant, Engelbach, secretary to the Director of Artillery crucial.
Morley recommendations	Centralised structure of Ordnance Factories under a Director General. Accounts, stores and audit procedures centralised.
1889-1890	Army and Navy Audit Act. Parliamentary vote for Ordnance Factories separated from army vote.
1889	First civilian Director General of Ordnance Factories.
1893	Eight-hour day introduced into Ordnance Factories.
1898	Office of Chief Mechanical Engineer initiated.

1899-1902	Second Anglo-Boer War.
1904	Master General of the Ordnance resurrected.
1904	Retrenchment.
1904 1907	<p>Esher 1904) Mowatt 1904) Reports Henderson 1907) Superintending managers doubled up Murray Report 1906, leading to the Hadden report 1909-1911, removal of surplus production capacity of Royal Arsenal. Army Pay Department - disbanded - 1904. Army Contracts Department - disbanded - 1904.</p>
1906	Haldane - Secretary of State for War, creation of order of battle on BEF system. LSE Army class. Expansion of regular reserve and territorial force to meet growing German threat.
1907	Army Contracts Department resurrected.
1909	Army Pay Department resurrected.
1914	4th August: First World War begins.
1915	Ministry of Munitions established, takes over control of Ordnance Factories.
1915-1918	Reinventing the wheel? Professional accountants as temporary civil servants. Costing. Recent evidence suggests Elbourne's Factory Administration was responsible. The argument that these reforms were already in existence in Ordnance Factories have never been put forward. Official history states that DEB was introduced into the Ministry in March 1917.

Key personnel in the nineteenth century reforms	<p>John Anderson - inspector of machinery and later superintendent, Gun Factory. Robert Fraser - Manager, Gun Factory. H.W.S. Whiffin - Assistant Accountant General. J.C. Hurst - described in 1864 as Accountant 3rd class, Accountant General's Department, later Chief Accountant and auditor of manufacturing department. L. Engelbach - principal clerk to Director of Artillery, later Assistant Accountant General. James McGee, Manager, Royal Small Arms Factory, Enfield. H. Campbell Bannerman, Secretary of State for War. J. Grimwood, Controller Cost Accounts at the War Office.</p>
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CHAPTER 2

The Concept of the Soldier-Technologist and the Growth of the Professional Manager

Introduction

This chapter deals with the background of management in Britain in the first half of the nineteenth century. In particular it explores the concept of the soldier-manager-technologist in the British Army, since they are the key to later innovation within the British and Indian Ordnance Factories, and also important more generally in the growth of management. Mass production, cost accounting and scientific management were areas that did not transpose into British industry in the private sector until well into the twentieth century, although it is argued in this thesis that these developments were experienced in the Ordnance Factories from the mid nineteenth century.

However, there is evidence to suggest that a soldier-technologist concept did exist and, in some cases, the British Army and the Army of the Honourable East India Company were used as a training ground for management in the private sector, particularly in the Victorian railway industry. The Victorian railway companies were examples of large-scale enterprises. However, large enterprises existed before the railways, a point noted by Pollard:

"new industries which began on a large scale without a craft or domestic background, such as distilling, brewing, sugar-refining and soap boiling where men were employed direct from the beginning and supervised by the firms' foremen." (1966: 19)

The demand for a "managerial or supervisory" class within the workforce increased as large-scale enterprises expanded. The division of labour widened into those who supervised and those who were supervised. In relation to the Army, during both the eighteenth and nineteenth centuries it was perhaps the largest public sector organisation in Britain and was structured on a hierarchical rank system.

There were a number of routes which involved the training and education of

managers. Although there is evidence to suggest that 'managers' of the eighteenth century onwards were probably well versed in what may be termed management skills, many of these skills were learned on the job. But the term 'manager' was a term not understood in the eighteenth and early nineteenth centuries. Thus the practical man concept is an important consideration when assessing the concept of managerialism. Despite this, other skills which could be adopted for managerial expertise were sometimes gained from the varied sources of schooling that existed. However, there was no formal management education in Britain as such until well into the twentieth century. Perhaps the Royal Military Academy (RMA), Woolwich together with the Honourable East India Company's college at Haileybury were the closest to a formal management school which existed in Britain during the eighteenth and nineteenth centuries. Haileybury College also trained military and civil officers for service with the Honourable East India Company. In 1872, the Royal Indian Engineering College was founded at Cooper's Hill, Esher, Surrey and existed until its closure in 1906. Cooper's Hill College was a state-owned institution run by the India Office and its role was mainly to train engineers for the Indian PWD. From the late eighteenth century until the early 1870s, the role of the Military Board and its successor the PWD expanded from being the engineering wing of the Army in India, concerned only with military projects, to being responsible for a whole range of public works projects. Until the early 1870s the PWD was generally staffed by military engineers, though a few civilian engineers, called Stanley engineers, were being recruited from the 1860s onwards. The Accountant General and accounting staff for the PWD in each Indian province was a senior Royal Engineers officer and this continued until the First World War.

This transition from military to civil engineering projects needed civilian engineers rather than military and Cooper's Hill College was established to supply this need. The Royal Indian Engineering College from 1872 onwards expanded its curriculum to include civilian engineers not only for the Indian PWD but for the Colonial Service generally. The type of engineer ranged from railway engineer to forestry and telegraphic engineers (India Lists, 1872 to 1905). Military students from the Royal Engineers and Royal Artillery, who were destined for the Indian Ordnance Department, also attended Cooper's Hill College prior to taking up appointment.

The RMA Woolwich trained gentlemen cadets for commissioned rank in both the Royal Artillery and Royal Engineers (collectively known as the Scientific Corps of the Army). The Royal Engineers during the nineteenth century were instrumental in civil engineering projects in India. This included land drainage, canal and railway construction and road building, as well as military construction projects such as barracks and Ordnance Factory development. There is evidence to suggest that book-keeping may have been taught at RMA Woolwich from the eighteenth century. However, General Sir George Chesney, Royal Engineers, who in 1860 became the Accountant General to the Indian PWD, lamented the lack of accountants within the PWD and the drudgery of book-keeping which befell engineering project officers (Chesney, 1859). Chesney was instrumental in forming the Royal Indian Engineering College in 1872.¹ From 1879 onwards accounting was introduced into the curriculum.

¹ Chesney's brother, Colonel Charles Chesney, also of the Royal Engineers, was influential in establishing the first Army Staff College at Sandhurst in 1856. Charles Chesney became Professor of Military History at the Staff College from 1858 to 1868 and was a member of the Royal Commission on Military Education from 1868 to 1870. He was sent by the government to report on the Franco-Prussian war in 1871. The Staff College was modelled on the RMA Woolwich and its curriculum included military engineering and fortification, military history and mathematics (*The Royal Engineers Journal*, 1 June 1895: 213-4). RMA Woolwich was also the model for the Royal Indian Engineering College at Cooper's Hill.

Officers of the Royal Artillery were employed in the Ordnance Factories both in England and in India from 1855 onwards. They were employed as junior staff officers, as instructors and examiners (quality control) and as superintendents of individual factories, having overall managerial command of a mainly civilian workforce. From 1855 onwards the Ordnance Factories both in England and India developed into large-scale enterprises. Evidence presented in this chapter identifies the managerial skills of the officers of the Scientific Corps as soldier-technologists.

Since the early nineteenth century, all Army officers were subject to audit by a twice-yearly confidential reporting system. This was being practised at a time when most infantry and cavalry officers of the British Army bought their commissions under a complex system of patronage. Officers of the Royal Engineers and Royal Artillery were selected on merit for promotion - commission by purchase did not extend to the Scientific Corps. However, the concepts of manager and management were not understood in Victorian military society.

The system of confidential appraisal of managerial grades in commerce and industry did not happen on a regular basis until well after the post-1945 era in Britain.

The chapter also looks at the growth of contemporary management in the private sector. The growth of any formal management education in the private sector was marred by the difficulties in reconciling the liberal arts and the sciences. Thus the major development was apparent by the practical man concept (Barnett, 1985). The reconciliation of the 'arts' and sciences of management, it is argued, had been achieved at RMA Woolwich and is evident from its curriculum from the eighteenth century.

The concept of the soldier-technologist: the experience of the United States Army and the reforms at West Point Military Academy from 1819

Much of the argument for the genesis of the modern business structure originating in the American Army can be traced back to the reforms of West Point Military Academy in 1819. The reason for these reforms were part of a wider restructuring of the American Army, particularly the US Ordnance Department and the Corps of Engineers from 1815 onwards. This was as a direct response to the misfortunes of the American Army in the war with Britain from 1812 to 1814.

The West Point reforms were undertaken at the direction of the fourth superintendent of the Academy, Sylvanus Thayer, who was appointed to the post in 1817. These reforms have been well researched in Britain by Hoskin and Macve (1988: 1994). Thayer modelled West Point on the French Ecole Polytechnique structure both in terms of the curriculum taught and the disciplinary pedagogy of "constant deployment of writing, examination and grading" (Hoskin and Macve, 1994: 81). The curriculum was scientifically based on the great French scientific texts.

Thayer introduced management concepts within the organisation of West Point's hierarchy which apparently may have been the practical origins of the modern American business structure. Accordingly Thayer adopted a management role and style similar to a modern chief executive officer (CEO) by issuing orders in writing and establishing line and staff management structures.

Students' performance was graded and recorded in an individual weekly account, together with a weekly class report. The results were factored together for the twice-yearly examinations, eventually being totalled up for a final Annual Merit Roll.

The reforms of West Point permeated into the Ordnance Department, thence into the Springfield Federal Armory during the 1830s. This concept is explored more fully later as it is crucial to the mid-nineteenth-century reforms of the British Ordnance Factories.

In America, by the 1880s Captain Henry Metcalfe had developed the earlier accounting reforms of the Springfield Armory into the concepts of scientific management. The Springfield Armory had evolved into a factory system during the American Civil War when Springfield was under the control of Colonel Alexander Dyer. The development of scientific management tends to equate to a factory system, however a similar system developed in the British Ordnance Factories which evolved into a factory system from the Crimean War. However, as was previously mentioned, factories existed prior to the development of scientific management (see Pollard, 1966: 19). The system that evolved in the Ordnance Factories included changes in the production process, the extensive use of semi-skilled rather than skilled (craft) labour, the employment of labour on a master-and-servant contractual basis. This is in contrast to subcontracting in labour (as was evident in the Springfield Armory until the American Civil War) or craft labour, as was evident in the pre-1858 workshop environment of the Royal Arsenal, Woolwich. Although the production process of interchangeability was imported from America, there is no relationship to suggest that Metcalfe's reforms actually influenced similar reforms of scientific management in the British Ordnance Factories. On the contrary, it is possible that scientific management evolved in the British Ordnance Factories prior to the reforms as postulated by Metcalfe. However, the evolution of scientific management in the American federal armories and British Ordnance Factories was a development from the earlier account-

ing reforms. The components of scientific management as they evolved within the Ordnance Factories are referred to later.

The genesis of modern managerialism as experienced in America arguably came from the West Point reforms. Hoskin and Macve (1994: 82) challenge Chandler's original contention when he played down the West Point connection, particularly in relation to railroad management. Chandler also contends that West Point acquainted US military engineers and Ordnance Department officers with bureaucratic "hierarchical organisation in antebellum America" (Chandler, 1977: 95). Hoskin and Macve argue that the origins of interchangeability at the Springfield Armory and the beginnings of the 'American system of manufacture' was the direct result of the West Point connection, particularly with the US Ordnance Department.

The growth of multi-unit enterprise business organisations with the American railroad systems were due to the secondment of officers of the Corps of Engineers to the civil railroad companies. Both the Ordnance Department and the Corps of Engineers took the cream of West Point graduates. Hoskin and Macve develop this particular argument to the West Point 'second generation'. Their 1997 paper considers that there was a network of West Point graduates from the post-1817 period. These graduates disseminated new practices, which broadly equate to those described in Benthamite terms through "grammatocentrism" and "calculability". "At everyday level what we are observing is a new way of constructing space / time relations" (1997: 6).

This is defined in the concept of writing and grading:

"An orientation to time facing towards the future - but a future which is to be known by drawing on the medium of objectivity measured and graded past performance." (1997: 6)

Hoskin and Macve attempted to clarify how time is rewritten, in a continuing process, as follows:

"(For it is not just that clock-time replaced body-time, clock-time is then rewritten [e.g. as the 'machine hour'] to produce a new quality of time-control and time-knowledge)." (1997: 6)

Co-ordinating the concept of space was disseminated through a new sense of extensive and intensive co-ordination and control. This was through administrative co-ordination. Here, managerialism can know and control the extreme parameters of the organisational space. New structures and scales of organisational complexity and size could be devised through divisionalisation and matrix structures, which penetrated to every corner of the organisation. Foucault called this a kind of panopticism (Foucault, 1975; Hoskin and Macve, 1997: 6). Hoskin and Macve suggested that "specifically it is a grammatocentric panopticon" (1997: 6).

The nucleus of this transition into the Springfield Armory and other federal armories was through West Point graduate US Ordnance Department officers appointed by George Talcott (Head of Ordnance) as officer-inspectors in the Ordnance Department. This cadre of officer-inspectors, together with their chief accounts clerk of the Ordnance Department and the Chief Inspector of Contract Arms "formed a bureaucratic team of middle managers whose separate but interrelated activities vastly improved the internal rhythm of ordnance enterprise" (Roe Smith, 1985: 69).

Chandler (1977) considers the evolution of a modern business enterprise in the USA as "a necessary and rational response to prior economic and technological change" (Hoskin and Macve, 1997: 6). Indeed, Chandler specifically considered that "modern business enterprise was thus the institutional response to rapid pace of technological innovation and increasing consumer demand in the United States during

the second half of the nineteenth century" (1977: 12).

Chandler conceded that there was something strange here. He assumed that the military had only an indirect impact on the beginnings of modern business management. His "pioneers of modern management" (Hoskin and Macve, 1997: 4) were:

"a new type of businessman. It is worth emphasising again that they were salaried employees with little or no financial interest in the companies they served. Moreover they had specialised training." (Chandler, 1977: 95)

Chandler has misjudged the importance of the US military. It is a theme developed by Hoskin and Macve and on closer examination of the key changes first identified by Chandler, some revelations are brought to light. The two pioneers at the Springfield Armory (single-unit factory management) and the Western Railroad (multi-unit enterprise) were Daniel Tyler and George W. Whistler. Both were military officers who had gone through the same specialised training, graduating together from the reformed West Point Military Academy in the class of 1819. Neither had ever run a business enterprise in their lives (Hoskin and Macve, 1997).

Hoskin and Macve contend that:

"... we have argued that historians of modern business have generally been looking at the wrong technological stimulus, for they should have been looking at the development of the invisible technologies: writing, examination and grading. The reason why the USA (then only a marginal player on a world economic scene, dominated by Europe and, in particular, Britain) invented the 'modern business enterprise' around 1840 is to be found at West Point before 1820." (1997: 5)

Hoskin and Macve have moved forward Chandler's pioneering work to suggest that there is a close connection between the development of modern business culture and the earlier reforms of the US Army.

From 1815 to the Mexican War of the 1840s, America was not involved in any major armed conflict. The American Army was deployed in protecting an ever-

widening frontier, the Army being engaged in only minor Indian wars. As with contemporary British society, the American taxpayer did not wish to expend vast sums of public money securing a large army which could be a threat to the democratic image. Thus the production of ordnance at a federal workshop was positively encouraged to develop efficiencies. The American and British systems of arms procurement were also subject to competitive contract and War Department orders went to the most efficient producer, whether a Federal armory or private contractor.

Both the US Ordnance Department and Corps of Engineers took the best graduates from West Point. Officers of the Corps of Engineers were seconded to the developing American railroad companies, which were ever-expanding westwards. O'Connell states that "the organisational and administrative experience these officers brought to the railroads had great influence on the early development of the art of management in the United States" (1985: 88). The US military obviously benefited from the development of the railroad system as it meant troops could be deployed more quickly to the frontier.

The soldier-technologist experience from the perspective of the British Army

Recent research has tended to focus on the concept of the soldier-technologist of the American Army in relation to the development of modern American business (Chandler, 1977; Hoskin and Macve, 1986, 1988, 1994, 1997). Little attempt has been made to suggest that a similar concept could be derived from the experiences of the British Army. The contention of this thesis also suggests that a soldier-technologist also developed in the British Army.

The problem raised by recent research into the concept of the soldier-technol-

ogist and the development of the corporate structure in American business during the nineteenth century, is whether any similar development was apparent in the British military administration.

The first point to be raised here is that there was no parallel in Britain to West Point Military Academy but it is argued that RMA Woolwich was close to fulfilling a similar role. The Scientific Corps of the British Army (the Royal Engineers and Royal Artillery) trained their cadets at RMA Woolwich, whereas officers for the Army generally were trained at Royal Military College (RMC) Sandhurst. The Royal Military Academy (RMA) Woolwich was older than the Royal Military College, Sandhurst, having been founded in the first half of the eighteenth century. RMA Woolwich was always known in the contemporary Army as 'The Shop'. It was not obligatory for officers of the cavalry or infantry to attend any military academy, unlike the experiences of Prussia and France where there was a compulsory requirement for their potential military élite to have graduated from a military academy. This was also the experience in America after the West Point Academy reforms. West Point was modelled on the French Ecole Polytechnique. As mentioned earlier, the first British Staff College was only established in 1856 to train middle-ranking officers to the higher echelons of command.

Basically, the experiences as manifest in the American and British armies were different. The contemporary British military experience was broadly similar, although it is not suggested that from this experience developed any modern business organisation as such. What did develop was more of a modern business culture, which for the British Ordnance Factories from the mid nineteenth century, made them into single factory units of production which, it is argued, were more efficient than their

private sector counterparts.

'The Shop'

Woolwich during the second half of the nineteenth century until the First World War, reflected a 'Solomon's House'. Here there was a link between the liberal arts, science and technology, the practical and professional. Woolwich Garrison was the home of the Royal Artillery, one of the two scientific corps of the Army and the Royal Arsenal. Close by was Chatham Garrison, home of the Royal Engineers, the second scientific corps of the Army.

Until the 1840s, the RMA was located within the estate of the Royal Arsenal. The RMA was always known as 'The Shop' but the origins of this nickname are not absolutely known for sure. A paper published in the *Journal of the Society of Historical Research* in 1925 stated that:

"In a letter written by second captain RM Cairns Royal Artillery then in Portugal dated 4 April 1813 to a brother officer at Cadiz gave the following information: 'I can send you no news, and therefore crammed you well with the Shop'."

A later history suggested that

"It is possible that the Royal Military Academy Woolwich has acquired the sobriquet 'Shop' in this connection, as being the seat of learning, or institution where professional military subjects are taught. Major General Sir A.E.H. Anson Royal Artillery, who was at the Shop in 1841, wrote in a letter of 1 December 1923, 'I believe the name Shop was given to the Royal Military Academy, Woolwich as a familiar name for the place where cadets were housed and did their business of instruction for the Army'." (Jones, 1954: 114)

The general opinion amongst the staff of the Royal Artillery Institution, among them senior officers of the Royal Artillery, is that unlike the rest of the officer corps of the regular Army, the officers of the Royal Artillery and Royal Engineers, who

entered the Army via RMA Woolwich and its preparatory school, Addiscombe, were the sons of small tradesmen. This may have some implication that the Woolwich cadets had some commercial awareness. The length and breadth of the curriculum at RMA Woolwich was far more advanced than at the Royal Military College, Sandhurst, formed some forty years after RMA Woolwich.

The experience of RMA Woolwich during the eighteenth century reflected an advanced curriculum for the age, compared with other English institutions. From 1773 to 1809 the mathematician, Charles Hutton LLD FRS, was Professor of Mathematics at RMA Woolwich. Hutton (1737-1823) was born at Newcastle-upon-Tyne and followed his father as a colliery labourer. Hutton acquired a taste for books and at the age of 18 he became the village schoolmaster at Jesmond. Later, Hutton opened a mathematical school in Newcastle. In 1764 he wrote his first book *The Schoolmaster's Guide* and later was appointed as Surveyor to Newcastle-on-Tyne.

The experiences of Charles Hutton are important when assessing the genesis of modern managerialism, particularly in relation to RMA Woolwich. Hutton was appointed as Professor of Mathematics to the RMA in 1773 and one year later was elected as a fellow to the Royal Society. Between 1776 and 1778 Hutton researched and published papers on the *Force of Exploded Gunpowder and the Velocities of Balls* for which he gained the Copley Medal.

Pollard related that the curriculum of RMA Woolwich during the period of Hutton's tenure:

"... included writing, arithmetic, merchants accounts (or the true Italian method of bookkeeping), algebra, geometry (elemental and practical), mensuration, trigonometry, projection of sphere, conic sections, mechanics, statics and hydrostatics, doctrine of fluxions, etc. together with their various applications in Navigation, Surveying, Altimetry and Longimetry, Gunnery, Dialling, Gauging, Geometry, Astronomy etc."

(1966: 141; see also *Records of the Royal Military Academy 1741-1892*)

The internationally renowned pioneering English chemist, Joseph Priestly (1733-1804), was sometime Professor of Chemistry at RMA Woolwich.

The student numbers at any one time never exceeded 200. In 1855 there were 180 cadets of whom 40 of the "first or practical classes under the able instructors in the art of fortification" were instructed on the Royal Foundry (*The Army List*, 1856). The number of students in 1904 was 169, who were divided into either the Artillery or Engineer Division. In 1881 arrangements were made for an "interchange" of textbooks between RMA Woolwich and the Military Academy at West Point, USA (*Record of the Royal Military Academy 1741-1892*: 165).

Having described the reforms of RMA Woolwich since the eighteenth century, it is pertinent to point out that it was not as advanced as either a contemporary West Point Military Academy or the Ecole Polytechnique, or even the Prussian military academies. However, in terms of scientific and management education in eighteenth and nineteenth-century Britain it was the best in the nation. The failure of British artillery and logistical detail in the Crimean War in the wake of superior French logistics and ballistics is an example of this. Neither did the concept of the soldier-technologist manifest itself in Britain in the way it did in America after the West Point reforms of 1819. However, the British military experience of the emerging soldier-technologist was much smaller than in contemporary America. The influence of the RMA Woolwich graduate and the soldier-technologists was seen more in India than in Britain.

The legacy of RMA Woolwich: the example of the Indian Public Works Department

The legacy of the RMA Woolwich is evident from the reforms of the Indian PWD, particularly in the post-1858 era. A resumé of the PWD was given earlier in this chapter, in relation to the Royal Indian Engineers College. The Accountant-General of the PWD were senior officers of the Royal Engineers, the most influential being General Sir George Tomkyns Chesney KCB MP (1830-1895). Chesney was born in Devon and originally began to study medicine but was persuaded to take an Indian cadetship instead. He entered Addiscombe for a year, then entered RMA Woolwich, being gazetted as a second lieutenant in the Bengal Engineers on graduation in 1848. Chesney was a prolific writer whose numerous papers were published in the *Calcutta Review*.

In his writings, Chesney described how the concept of the professional engineer evolved throughout the eighteenth and nineteenth centuries, particularly from the viewpoint of the military engineer in India. The evolutionary process grew from a previously haphazard system of tacit learning and the concept of the practical man, with the exception of a few distinguished engineers such as Smeaton.

"But, at the end of the last century, there was no such recognised profession as the engineer's; engineering works were comparatively of a simple kind and were generally executed in an empirical haphazard fashion ..." (*Calcutta Review*, vol.64, 1859: 348)

Chesney argued that the post-Mutiny era from 1858 was beneficial for the PWD as it would entail a more vigorous prosecution of public works.

It is evident from Chesney's writings that a great deal of the PWD project engineer's time was spent on accounting and costing. The basis of this appears to be quite elaborate, given that there were no accounting bodies at this time. However,

it does reinforce the argument put forward in this thesis that the reforms of the Ordnance Factories came from gunner officers who were (as were sapper officers) trained at RMA Woolwich. Much of the system of accounting in the PWD was based on budget accounting rather than DEB.

Chesney described the duties of a project officer (normally a subaltern of the Royal Engineers) as being engaged in bridge or railway construction and the accounts of work to be taken.

"Accounts involving to a large extent dealings with day labourers and of materials which are constantly undergoing a change of value and form must always be of a complicated and intricate character. These accounts of work will indeed be usually more intricate than mercantile ones, for while the goods of a merchant remain invariable in form, a hogshead always a hogshead, a bale of cotton always a bale of cotton, the materials on an Engineer's books are constantly going through a process of change. The mud worked up into a sun-dried brick gradually becomes transferred, after a mixture with other materials, into the finished masonry wall. The tree purchased while growing in the forest is first enhanced in price by the cost of felling it, and further by the cost of transferring it to the place where it is required. When sawn up into logs or planks the fractional cost of the tree, which represents the value of each log or plank, is to be increased by a part of the sawyer's wages, of the wear and tear of his tools, and further by a share of the cost of the shed built to protect it from the weather, and of the watchman's pay who looks after it.

After this, it will probably be worked-up for use with other materials, the prices of which have been determined in an equally complicated way, the price of the whole combined into a manufactured state being further increased by the cost of the labour to do so.

So with lime, cements, paints and all other materials. To keep exact accounts of them through these transactions, and to be able to show what they are worth at every stage of the operation, involves account-keeping of a very complicated and difficult character.

Heavy cash accounts with contractors and day labourers, though simpler than stock accounts, require method and attention, and it will therefore be readily understood that with every Engineer his accounts come to be considered a very important, often the most important, part of his duty." (*Calcutta Review*, vol.64, 1859: 359)

This system was not standardised until Chesney's Public Works Department reforms were implemented as policy.

"Each officer was therefore left to himself to establish his own system of book-keeping, and the result was what might have been expected. Some few went to principles and did well, some hit upon plans which gave them correct accounts exhibited, and all necessary details, but with vastly unnecessary complication of books, and requiring the constant attention of the officer himself ... and if ever accomplished involved an amount of mental labour that, properly applied, would have made the unhappy officer a finished accountant." (*Calcutta Review*, vol.64, 1859: 362)

Such systems lagged and the Public Works Department found itself greatly in arrears regarding the auditing of such accounts. Chesney's own recommendations for reform were ultimately accepted.

"The Commission knew well that in India the man who spends the money must be the one to account for it, that the Engineer must also be the responsible accountant, however uneconomical the distribution of labour may apparently be; but assuming this to be fixed, they suggest several means of lightening his labour. The principal of these were:

1st, a more rapid audit, which they proposed effecting by having a separate audit office for each province, and by permitting a greater latitude in the difference between the estimate and bill, thus rendering the preparation of the latter easier.

2nd, that every executive (engineering) officer should be properly instructed in the principles of account keeping.

3rd, that a responsible accountant should be attached to every office to relieve the Engineer from the main drudgery of the books and give him more time for his engineering duties." (*Calcutta Review*, vol.64, 1859: 362)

The recommendations of Chesney, which were eventually accepted by the India Office, are remarkably similar to the grammatocentric panopticon of the West Point educational revolution as described by Hoskin and Macve (1994: 81).

Chesney also described the training of both the civil and military engineer for

service in India. He acknowledges the long relationship of the Executive Officers of the Indian provinces being appointed from the Royal Engineers and, as with the US Corps of Engineers, the Royal Engineer Officer, "the greater part of which from its first establishment has always been employed in civil duties during peace time" (*Calcutta Review*, vol.64, 1859: 369). This is very much true of Victorian social reform. Sapper officers were employed in penal administration, notably Major Generals Sir Joshua Jebb and Edmund du Cann. Their monuments of two London prisons, Brixton and Wormwood Scrubs, still stand as operational establishments. The creation of the Science and Art Department at South Kensington in 1857 was directed for much of its life until 1898 by Major General William Donnelly RE, epitomised by Gilbert and Sullivan as the "very model of a modern major general".

Chesney also remarked that the engineer officer so employed on these duties received no special training, except perhaps on-the-job, or sit by Nellie. All Royal Engineer cadets were trained at RMA Woolwich and later a second college at Cooper's Hill, Esher was opened, particularly to train civil engineers for the Indian service. Chesney suggested that the best military college in mid-nineteenth century Europe was the Ecole Polytechnique in Paris, stating that:

"Admission to the Polytechnic is open to very severe competition among all the youth of France; the cadets who enter it are therefore all well educated, and their general qualifications much more equal than Addiscombe, where a considerable number never make an effort to compete for the Engineers. The newly modelled senior or scientific department at Addiscombe will probably not come far short of the Polytechnic. The system at [RMA] Woolwich resembles that at Addiscombe but the advantages of entering the Royal Artillery or Engineers are so closely balanced that many of the cadets choose the former. The proportion of appointments given to the Engineer Corps is usually larger than Addiscombe, which tends to diminish competition and, probably from these causes, the standard of education at Woolwich has been for some years much lower than at Addiscombe." (*Calcutta Review*, vol.64, 1859: 369 (footnote))

From Addiscombe or Woolwich the cadets of the Royal Engineers then graduated to the Royal School of Military Engineering, Chatham. Part of the Chatham curriculum included civil engineering. On arrival in India, both civil and military engineering cadets entered the Public Works Department as assistants, spending a period of attachment with either the Bombay or Madras Sappers and Miners of the Indian Army. However, the papers written by Chesney and published in the *Calcutta Review* were influential enough to promote major reforms within the financial accounting and management system not only of the PWD from 1860 onwards but also with the Indian state railways. For his efforts, Chesney was appointed as Accountant-General to the PWD. Much of the accounting and financial management of the PWD until 1914 was undertaken mainly by officers of the Royal Engineers (India Office Lists, 1860-1914).

The Royal Indian Engineering College was also modelled on RMA Woolwich, the majority of its Army staff being officers of the Royal Engineers. During his ten-year presidency of Cooper's Hill College (from 1870 to 1880), some 3,110 civilian engineers graduated from the College for service with the PWD (*The Royal Engineers Journal*, 1 June 1895: 213-4). In terms of this thesis, Cooper's Hill College is important as the first lecturer in accounts was J.C. Hurst, appointed in 1879, who was also the Chief Accountant and Auditor of Factory Accounts for the Ordnance Factories. The influence of Hurst is crucial to the development of this thesis and is a link between Chesney and the PWD reforms. Hurst was a major player in the nineteenth-century managerial reforms of the Ordnance Factories. Cooper's Hill College may have been the first institution in Britain which exclusively had management and accounts in its curriculum and taught this for the public sector.

The identity of Hurst in the context of the syllabus of Cooper's Hill College is crucial as it points to evidence that cost accounting and scientific management were management practices being conducted in the Ordnance Factories from 1862 onwards. Accounting was first introduced into the Cooper's Hill calendar from 1879, the year Hurst was appointed as visiting lecturer in accounts. The accounts course was an obligatory course for all third-year students and included Mercantile, Banking and Government accounts, including the accounts of manufactories (Ordnance Factories) and of the Indian PWD (British Library, India and Oriental Collection ST 1378) (see appendix to this chapter for a detailed description of the accounting curriculum at Cooper's Hill College).

Also, stores accounting was a prominent part of the syllabus, including charging stores against the works on which they had been used. Contract accounts were also taken into consideration, for example labour-only contracts, and where labour and materials were both contracted for; work undertaken by one contractor, or various contractors. The syllabus did not change from 1882 to 1903, when accounts as a subject was withdrawn from the curriculum two years before Cooper's Hill College was closed (British Library, India and Oriental Collection, Cooper's Hill Calendar, ST 1378).

The reforms of the Ordnance Factories in Britain and India came directly from America after the visitation of the Board of Ordnance Commission to the US Federal Armories in 1855. However, the introduction of reformed accounting systems into the Indian Public Works Department and the British and Indian Ordnance Factories was simultaneous with the reforms in the American federal armories.

Indeed, in January 1914 a paper appeared in the *Army Review* which became

the catalyst for the later cost accounting experiment in the British Army from 1917 to 1925. Major H.A. Young wrote in the *Army Review* of January 1914:

"No matter how supplies of equipment, food, pay, clothing etc. reach a unit, the unit should be self-contained itself and be directly responsible for all expenditure which is incurred in its upkeep, and that unless it is economical it cannot be efficient. Charge against such unit every item of expense incurred by it, discriminating, of course, between items which it can control and those which are fixed. I do not say that the data obtained can be taken by themselves, or that the early results will be accurate. Many factors must be considered, such as the date of issue of the equipment, service on which the unit has been employed, its station and other circumstances. As time goes on, however, the accumulated data will become more and more valuable and accurate, and an intelligent comparison of unit with unit will be a practical means of judging to what extent economy has been obtained, and will enable those responsible to the state, for the Army as a whole to reward the efficient and punish the wasteful." (*Army Review*, 1914: 225-230)

Young was an officer in the Royal Artillery who spent all his service from 1888 to 1921 with the Indian Ordnance Department, being superintendent of a number of Indian Ordnance Factories and later in 1917 becoming Inspector General.

The point being made here is that Young's experience within the Indian Ordnance Department was very similar to that experienced by the gunner officers who were superintendents of the British Ordnance Factories. As with officers of the Royal Engineers, they were the soldier-technologists of the nineteenth century. Their knowledge of accounts and cost accounting was probably learned through on-the-job learning rather than through any specialised training, as was apparent from America and the West Point connection.

Officers of both the Royal Artillery and Royal Engineers also held junior positions within the British and Indian Ordnance Factories. From the mid nineteenth century, training for officers appointed to the staff of Ordnance Factories was formalised, which continued until the First World War. A number of Royal Artillery

officers spent large parts of their service with the British and Indian Ordnance Factories, as was evident from the career of Young. From 1860 until 1879 the Superintendent at the Royal Laboratory, Royal Arsenal, Woolwich was Major General Edward Mourrier Boxer RA FRS. Boxer's career is further explored in Chapter 8.

Patronage and professionalism: the audit of the Victorian Army officer

Despite the concept of patronage within the purchases of Army commissions, there was a stringent audit of commissioned officers within the Army, through a system of twice yearly confidential reports. This, as Harries-Jenkins (1977) pointed out, was well over a hundred years before a similar model was used in the private sector. Thus the presumed inefficiency of commissioning through purchase begins to be challenged as the system itself was thoroughly audited.

The confidential reports of the general officers commanding brigades were passed to superior officers along the chain of military hierarchy. For example the brigade general officer would pass his inspecting confidential report to the officer commanding a district, then command until they arrived at the Adjutant General at the War Office. Each receiving officer could add to the confidential report, perhaps in the same manner as a 'grandparent' in the modern sense of an appraisal system. The Adjutant General would then forward these reports together with any observations "which they may judge it expedient to add ... for the information of the Commander-in-Chief" (Queen's Regulations [QRs] for the Army, 1859: 404, para.4).

Harries-Jenkins (1977: 82) refers to the confidential report system for officers of the Army from 1850. The earliest King's Regulations (KRs) held in the National Army Museum at Chelsea, London are for the year 1837, the last year of the reign

of William IV. The 1837 KRs from pages 473 to 498 deal specifically with confidential report for officers, where it commences that:

"... every General Officer employed on the staff whether at home or abroad is required to make a confidential report in the early parts of the month of May and October in each year, or as soon afterwards as the circumstances of the Service will permit of what has fallen within his observation on those important subjects since the previous inspection." (KRs, 1837: 473)

"These Reports are, as far as practicable, to be the result of continued intercourse and observation and not to be confined to an inspection at any particular time." (KRs, 1837: 473)

The nature of confidential reports for the British Army throughout the nineteenth century appears to be of an unscientific design. There was, for the most part, no prescribed printed sheet. The General Officer made his report in long-hand on a sheet of paper following the guide in King's (Queen's) Regulations.

However, despite the supposedly unscientific nature of the system of confidential reporting, the system existed long before its development in the private sector. The audit of officers in the nineteenth century perhaps increased their efficiency and professionalism, through the entry of the majority of officers into commissioned ranks of the Army by purchase and patronage.

This system of annual confidential reporting was also introduced into the reformed Purveying Department to the Army in 1857. The original Purveying Department had come under criticism during the Crimean War, and was one of the first departments to undergo transition in the immediate post-1856 period. Indeed, the Purveying Department was close to the Ordnance Factories.

The qualification and conduct of Purveyors clerks were to be confidentially reported upon annually, by the Purveyors under whom they served. The report was based on the following points:-

- The range of duties upon which they have been employed during the year
- The manner in which these duties have been performed
- Punctuality
- Knowledge of current regulations and duties of the Department generally
- Their knowledge of mathematics and of accounts
- Their skill in composition, writing, calculations and the preparation of returns
- Their skill of acquaintance with French, or any other foreign language
- Their general conduct
- Their conduct as officers and gentlemen, prudence, respectability, courteousness, and whether it is known they have any pecuniary embarrassments.

These Confidential Reports had to be forwarded to the Purveyor-in-Chief by the 1st of January each year.

Also each Purveyor in charge of a station had to maintain a diary recording the daily hours of the clerks, any recorded absence and the tasks performed by each clerk on a daily basis. This diary had to be forwarded annually to the Purveyor-in-Chief (Regulations for the Guidance of Officers of the Purveying Department, first edition 1857, WO 33/4 A and B).

This example gives evidence of the confidential reporting procedures in detail with a small department of the Army. This illuminates previous arguments in this chapter concerning education for management, as well as the rationale behind the confidential reporting system. Equivalent managers in mid-Victorian commerce did not experience this type of regular audit.

Military officers as managers

Few commissioned officers of the British Army attended dissenting academies although officers of the Indian Army were sometimes graduates from these academies. An example was Captain Mark Huish (1808-1867) who was commissioned into the 67th Regiment, Bengal Native Infantry. Huish was a non-conformist, an unusual devotion at the time for a commissioned officer. His schooling was at a Dissenting Academy at Nottingham, identified by Wardle (1970) as a private writing school. Huish later became managing director of the London and North Western Railway.

The career of Huish as General Manager was to unite and centralise three railway companies into the London and North Western Railway Company. The obituary of Captain Huish describes his rule as "based on sound commercial principles, as well as upon an admirable system of centralisation" (*Minutes of Proceedings of the Institution of Civil Engineers*, vol.XXVII, Session 1867-68: 6D1).

Huish resigned his commission in 1834 due to poor career and promotion prospects. At this time many officers, both in the British and Indian armies and the Royal Navy, left the service for similar reasons. Many former Army officers became managers in the growing railway industry in Britain. Junior officers of the Army and Navy "had experience of accounts and bookkeeping and were also familiar with the control of large staffs" (Gourvish, 1972: 27). In the case of Huish, active service always eluded him. His administrative talent, due to his education, led him to become quartermaster and interpreter to his Regiment. Other former Army officers who became leading railway managers included: Captain William O'Brien, North Eastern Railway; Captain John Laws, Managing Director of the Manchester and Leeds; and Charles Saunders, Secretary and Superintendent of Traffic, Great Western Railway

(Gourvish, 1972: 27).

The Army and Navy were used as a training ground by officers for future management roles in the private sector. This was an unconscious decision; many officers left the Army early due to uncertainty and the inactivity of the Army between 1815 and 1854. The railway inspectorate of the Board of Trade was staffed exclusively by sapper officers since its formation in 1842. Indeed, the railway inspectorate became a sort of clearing house for officers of the Royal Engineers to be recruited into the railway companies. An example of this can be seen in the career of Captain Joshua William Coddington RE (1809-1855). Coddington was educated at the Royal Military Academy Woolwich and in 1840 resigned as a lecturer in military engineering. From 1844 to 1847 Coddington was on the staff of the Inspector of Railways at the Board of Trade. His obituary stated that "during that period he had been frequently solicited by railway companies to undertake the general management of their lines and eventually he accepted the post of General Manager of the Caledonian Railway" (*Minutes of the Proceedings of the Institution of Civil Engineers*, vol.XIV, 1854-55: 166).

The London and North Western Railway was also associated with the Moorsom family. Captain William Moorsom, on leaving the Army (7th Fusiliers), joined the staff of the London and North Western where his elder brother, Rear Admiral Moorsom RN was one of the directors of the company. Captain Moorsom's survey of the proposed railway link between Birmingham and Gloucester in 1836 was the accepted tender. He beat off competition from George and Robert Stephenson and I.K. Brunel (*Minutes of the Proceedings of the Institution of Civil Engineers*, vol.XXIII, Session 1863-4: 500).

The growth of professional management in the public sector in the eighteenth century: examples from the Naval Dockyards

The reforms within the Ordnance Factories in the nineteenth century did not occur in isolation. There is evidence to suggest that there was a growth of professional management in the public sector during the eighteenth century. Pollard has identified these reforms within the Admiralty dockyards. Indeed, Pollard notes and nearest parallels between the public and private sectors in terms of an identifiable management remuneration grades as manifest in the Admiralty dockyards and Office of Works (1966: 166).

The remuneration of the Comptroller of the Office of Works during the first quarter of the eighteenth century was £158 p.a. As this was the era of patronage, there were "several additions for perquisites and sinecures [which] raised to well over £700 by 1726" (Pollard, 1966: 167).

The master craftsmen at the Office of Works and clerks who were in charge of "the work had salaries of £25-£50 p.a., though some of them added to their incomes substantially by 'outside' contracting" (Pollard, 1966: 167).

The Admiralty dockyards, Pollard notes, had no such overheads. The Naval Dockyard at Chatham in 1700 paid its six chief officers £200 each, and £100 for three other officers "and the Bos'n [Boatswain] of the Yard" £80. The Purveyor, and all other master craftsmen and foremen, were paid around £50 (Pollard, 1966: 167). Again, Pollard notes that "these salaries remained unchanged in 1790, except that the Purveyor's salary had been raised to £100" (1966: 167).

However, Pollard in the examination of the paylists of Chatham Dockyards for the years 1700 and 1790 has overlooked another point regarding the 'Bos'n' of

the Yard, who in 1700 was salaried at £90 per annum, paid in the first quarter 1 January to 31 March 1700, £20, whereas his successor ninety years later, the then Bos'n of the Yard, one Thomas Mann, was now paid £80 per annum and for the first quarter 1 January to 31 March 1790 £20 (ADM 42/8; 42/81), a reduction of £10 per annum.

The implication of this would appear to be that there was some prejudice between a manager such as a purveyor who was in charge of indenting for all the stores and supplies needed for a thriving naval dockyard, which by 1790 was on 'active service', and the Bos'n of the yard, who had to have the managerial skills of logistically deploying the stores and labour to the correct objective and to control discipline and pay the dock labour. The position may roughly equate to a personnel manager. The tasks performed by Thomas Mann as Bos'n of the Yard at Chatham Dockyard in 1790 were perhaps more complex and sophisticated than those carried out by his distant predecessor some ninety years previously.

Contemporary civil British management in the late eighteenth and early nineteenth centuries

In terms of the soldier-technologist experience and from the perspective of the British Army and the underlying training at RMA Woolwich, although it was not as advanced as in the contemporary United States of America, it was far more advanced than what was offered in the British private sector. There were strands within the British educational system of the eighteenth and nineteenth centuries where a fragmented curriculum could provide subjects relevant to commerce and industry, such institutions ranging from dissenting academies to certain public schools. Indeed, there

was a rich diversity of schools and places of learning but they were not synthesised and were based upon a fragmented and varying localised system.

Pollard has identified the rich variety of these schools and sources of learning, noting that men such as George Stephenson, William Edwards, the Welsh bridge-builder Joseph Bramah, and Richard Trevithick amongst others "who had the village school as the main, or sole, basis of their formal education" (1966: 129). From this often followed some form of apprenticeship to a local craftsman.

The public schools also provided an education which proved useful for potential managers. In particular were the smaller public schools endowed as charities. These are known as the Taunton schools after a Royal Commission investigation into their endowments, chaired by Lord Taunton. The sons of local merchants, craftsmen and entrepreneurs were often sent to this type of school where arithmetic and the art of bookkeeping were taught. The dissenting academies excelled in the teaching of science.

The major public schools and the ancient English universities tended to permeate the concept of a humanist curriculum. This was particularly so at Eton, Harrow and Rugby, the great Clarendon schools. These schools and the ancient universities were "in many respects a club for young men of the nobility and gentry, or at least wealth" (Taine, in Coleman, 1973: 100). The new wealth of the rising entrepreneur class did not permeate the great public schools or universities in any great number until later in the nineteenth century. However, there was a different ethos in the north due to the Scottish enlightenment. Neither did the Clarendon schools nor the ancient universities offer any curriculum which would have direct transferable skills to business and enterprise. This is despite their earlier pioneering innovation

of DEB some centuries earlier. They reflected a gentlemen's club which, Coleman suggested, was as follows:

"... be it the right school for the young, the right university for the adolescent, the right club for the adult, was an integral part of the gentlemanly ethos in practice, just as was the unwritten code of behaviour. Both as a concept and as a practice, it has shown a powerful talent for survival." (Coleman, 1973: 100)

The major debates on English education, both in the nineteenth and twentieth centuries, were mainly concerned with scientific and technological education or the deficiencies thereof. In the nineteenth century there was the Devonshire Commission (1867) and the two Samuelson Commissions (1881 and 1884). Such debates hardly touched the "world of business at all" (Coleman, 1973: 101) and also hardly touched the Clarendon Schools nor the ancient universities, long attached to a classical curriculum, which suited a gentlemanly class who "were to live idly and without manual labour" (Coleman, 1973: 101).

However, there was the alternative point of view which could defend the existence of the English public school system, for example the emphasis of team working which developed due to the cult of sportsmanship in the public school curriculum (Jeremy, 1998: 390). Jeremy also highlighted other factors, for example "authority and hierarchy, team spirit, of respect for past experience... Christian-informed compassion and empathy likewise resonate with modern notions of HRM [human resource management]" (Jeremy, 1998: 391).

Much of the problem was due to the reliance of British entrepreneurs on the concept of the practical man, which is further explored in the next section. Coleman (1973) also relates to the theory of the concept of 'Gentleman versus Player', where the divide was quite rigid, although the divide could be crossed. For example, in

some industries this gentlemanly concept prevailed and was promoted. Coleman refers to Dr. Reader and his history of ICI (*Imperial Chemical Industries: A History. 1. The Forerunners 1870-1926*). Reader refers to the "Winnington Hall Club", begun at Brunner Mond's Cheshire establishment during the latter part of the nineteenth century. The Club continued into the twentieth century and was a management club. Its membership was reserved for gentlemen.

"Election to the club was narrowly restricted. Technical men of graduate standing - meaning for practical purposes chemists - could perhaps take it for granted: no-one else could, least of all engineers and commercial men..." (Reader, 1970: 218)

"The whole structure rested on class distinction. University men (amongst whom engineers were by no means automatically included) were gentlemen: the rest were not, unless they achieved the status by consent of those already holding it." (Reader, 1970: 219)

Coleman comments that even in a highly successful technologically and scientifically based organisation, the social strata of English society prevailed. This was not only unique to the 'new' industries: the concept of a gentleman's club was still the model for Courtaulds in 1952.

"For a long time there has been no fundamental change in the Board... The Executive Directors have directed and managed, and on the whole they have been successful. There has been a Gentleman's Club atmosphere in the Board Room and I believe it's true to say that over the year this has been spread to all departments of our business. It is, in fact, part of the goodwill of the company, which we must safe-guard. On the other hand great care must be taken to avoid inefficiency." (Quoted by Coleman [1973: 101] from Courtaulds' Archives, private memorandum by Sir John Hanbury-Williams, Chairman of Courtaulds, sent to four of his senior directors)

During the nineteenth century, two parallel distinctions emerged. Science failed to establish itself in the concept of liberal education. This led to the notion of science divided into pure and applied science: pure science including natural philosophy, could be pursued within the realm of the liberal arts by the cultivated amateur.

Rothblatt (1968: 268) points out that:

"The overwhelming majority of trained science and engineering graduates from all universities, chemists as well as physicists, were employed in teaching rather than industry. Manufacturers continued to favour industrial chemists or engineers who had received their training essentially in the works itself. The attitude that college life ruins a man for a business career was still prevalent."

The natural sciences taught at Oxford and Cambridge Universities did not encompass applied sciences and were part of the overall liberal arts curriculum as practised by both the ancient universities. This attitude may have been promoted by the English concept of a liberal education as practised in the ancient universities and Clarendon public schools where the notion of a practical man was regarded as being of lower status than that of a gentleman. Applied science was regarded as manual labour only, to be pursued by the practical man. The two cults were contemporary although divorced from one another. Rothblatt (1968: 268) argues that the:

"... leaders of commerce ... were reluctant to employ arts graduates. For at least sixty years (during the nineteenth century) prominent intellectuals, parliamentary spokesmen, heads of scientific associations and institutes, government committees and royal commissions had urged the schools to produce scientists and technologists to staff industry and increase the importance of British manufacturing."

The sources of the concept of the gentleman and the practical man were vested in the "embodiment of English education and the idea of a gentleman, and to the social nature of the English industrial revolution" (Coleman, 1973: 102).

Oxford University only established an engineering department in 1907, as a response to pressure from certain leading public schools who had introduced mechanics into their curriculum for boys who wished to pursue an engineering career. The creation of an engineering department at Oxford "became an 'urgent necessity' as parents now expected their sons to be able to continue these studies at Oxford" (Honey

and Carthays, 2000: 563-4). However, Oxford was thirty years behind Cambridge where a Chair in engineering had been founded in 1875. Despite this, few undergraduates read engineering at either university until after the First World War.

However, the engineering department, as well as the applied sciences, expanded at Oxford University in 1907 due to the closure of the Royal Indian Engineering College at Cooper's Hill the year previously. Prior to 1907 efforts had been made unsuccessfully to establish a Forestry degree at Oxford. This was achieved in 1907 but it was financed by the India Office and the students were potential PWD engineers. William Schlich became the first government professor also sponsored by the India Office. Previously, Schlich had been Professor of Forestry at Cooper's Hill College. By 1911, applied sciences departments had been established at Cambridge and Edinburgh (Howarth, 2000: 475).

As neither the ancient universities nor the public schools played a major role within the development of the British industrial revolution, the vacuum was filled by the practical man ethos, both socially, economically and politically.

The progress of the industrial revolution saw the rise of the practical man socially, economically and politically. The status of 'Player' according to Coleman was the ultimate goal of the 'Practical Man'. Coleman (1973: 103) argued that: "As industry consolidated its success and emerged as a recognisable possible route to this ancient goal [of gentlemen], so did further social development follow". Coleman refers to the new occupational patterns which emerged in which were to be found the industrial 'practical man', for example in the managers of factories and mills. Partners and directors who aspired to the requisite wealth could become gentlemen, whereas the practical man continued to exercise the technological criteria of industry.

The division in education, according to Coleman, split into what was conceived to be education required for gentlemen, and training for the players (Coleman, 1973: 103). However, the primary ambition of a player was to become a gentleman (Chandler, 1996: 292). Indeed, Wiener's thesis of the decline of the industrial spirit in England was due to a gentrification process (Wiener, 1981). Wiener's argument is not supported by all historians, however.

During the latter part of the nineteenth century, as the education and science debate intensified, the Gentleman versus Player argument became more evident. Criticisms were made of the public school and ancient universities by eminent scientists of the day, notably Playfair and Huxley. Both stressed the importance of science to business, indeed a dichotomy of interest was displayed by Huxley who, in evidence to the Samuelson Committee of 1867, stated: "If I intended my own son for any branch of manufacture, I should not dream of sending him to the university" (quoted in Coleman, 1973: 106).

Instead, Reader suggests that despite the attractions of the profession:

"An increasing percentage of school leavers went direct into business: 6 per cent from Marlborough in 1846 but 23 per cent in 1906; 6 per cent from Merchant Taylors in 1851 but 42 per cent in 1891; 9 per cent from Clifton in 1867 but 25 per cent in 1907; even Winchester sent 12 per cent of its leavers straight into business in 1893." (Reader, 1966: 212-214)

This suggests there was a middle-class basis for business education. Much of the innovation of the British industrial revolution was based on the concept of the practical man or gifted amateur (Barnett, 1990). Most inventors and entrepreneurs in the British industrial revolution were not educated to match their skills with an emerging economy. Unlike their American, German and French counterparts, British entrepreneurs in the nineteenth century were trained to manage small units based in

family capitalism.

A major reason for the failure of British capitalism in the latter part of the nineteenth century was its failure at business and management education, whereas American, French and German economies had developed processes for management education. This was a contributory factor in their industrial supremacy from 1870 onwards (Chandler, 1990: 291-2). During the period of the Great Depression, a number of Commissions of Inquiry were established to investigate the reasons for economic stagnation in Britain, and education featured in these. One such study was a comparative educational survey, undertaken by Matthew Arnold junior. As with other investigations, the deficiencies of British business, management and scientific education were noted but in reality little was successfully achieved to improve the deficit. Neither were business or commercial faculties so successful in Britain until the post-1945 period.

It was this factor and the reliance on the practical man ethos that resulted in the negative response to various commissions. For example, the net result of the findings of the two Samuelson Commissions (1881 and 1885) into scientific, technological and managerial education in Britain compared to Europe and America was a very weak and enabling (as opposed to mandatory) Technical Instruction Act of 1889. This Act only entered the statute book on its sixth attempt. The five previous attempts were undermined by entrepreneurs and trade unionists alike, particularly the ASE. Fears included the release of trade secrets and the demise of patent rights, whereas the ASE feared the loss of the craft spirit which, as will be demonstrated later in this thesis, was already a myth. The Act itself allowed local rateable authorities to levy a penny rate if they so wished, to finance science education. The government also

redistributed central funds originally earmarked for compensation for redundant publicans. Thus the finance behind the 1889 Technical Instruction Act was known as 'whisky money'.

The major controversy surrounding English education until 1914 was the dogma of religious controversy, better remembered through the stormy passage of the 1870 and 1902 Education Acts which consumed a great deal of Parliamentary time. Few British universities successfully offered any commercial or management courses until well into the twentieth century. Where some universities did attempt to introduce commercially orientated courses, these proved to be unsuccessful. For example, the London School of Economics (LSE) had been founded in 1895 and, in 1901, was one of the first higher education institutions in England to offer a business degree. However, an attempt to establish a Faculty of Commerce failed "because the University of London commissioners would not agree to it but they did allow a Faculty of Economics and Political Science (including Commerce and Industry) and the School set up its BSc(Econ)" (Keeble, 1992: 99). In 1932 the LSE began a "graduate programme in commercial education ... but there was no graduate work in Britain in commerce or business" (Chandler, 1996: 293).

Joseph Chamberlain's attempt to establish a Faculty of Commerce and a Bachelor of Commerce degree at Birmingham was rejected by Midlands industrialists. They were not

"... persuaded sufficiently to give the idea their financial backing, but Chamberlain was able to turn to a non-industrial source for the necessary initial funds. He persuaded Lord Strathcona (the Canadian High Commissioner and some time lecturer at Mason College) to allow his donation of £50,000 intended for the proposed University of Birmingham to be invested separately and the income used to support the new Faculty of Commerce. It began in 1902 in two rooms over a shop." (Keeble, 1992: 100)

W.J. Ashley became the first Professor of Commerce but "the level of industry's interest in the new Faculty of Commerce was disappointing. However much thought and effort had gone into the business degree, Birmingham businessmen were never attracted to the idea" (Keeble, 1992: 101). In his first annual report, Ashley reported that "the friends of the University must constantly bear in mind that the high-sounding designation 'Faculty of Commerce' is a prophecy and an ideal, rather than an accomplished fact" (quoted by Keeble, 1992: 101). Oxford and Cambridge, along with the civic universities, had a divorced relationship with the business and industrial world, treating each other with "indifference if not distrust and hostility" (Locke, 1986: 96, quoted by Chandler, 1996: 293).

Chandler also refers to the paucity of engineering courses at English universities. There were Chairs in engineering at Oxford, Cambridge and the civic universities, although "the professors who occupied them had few students. In 1913 the number of engineering students graduating from the universities of England and Wales was 1,129" (Chandler, 1996: 293). In assessing this, the concept of engineering and entrepreneurship (including management) in Britain was very much in the model of the "practical man" (Barnett, 1990). This practice was quite acceptable in contemporary society at the time. William Armstrong, known as an eminent nineteenth-century engineer and a pioneer in the reforms of the post-1855 Ordnance Factories, only took up full-time engineering at the age of 37, having a natural talent in mechanical engineering. Previously, Armstrong had practised as a solicitor in Newcastle upon Tyne (Warren, 1989: 13-18; Wilcox, 1999: 57).

The fact that Britain had experienced the first industrial revolution may have had an adverse effect later, particularly on the older British industries. This is

particularly so in relation to management and technology. Chandler again points to this in assessing the British steel industry, where "... entrepreneurs may have been paying the price of having been pioneers before the opportunities to fully exploit the new technology appeared" (1996: 285).

Having said this, the outcomes of the Devonshire Commission and the two later Samuelson Commissions, damning as they were regarding scientific and technological education and its apparent importance to national economic performance, were met with apathy from parliamentarians and entrepreneurs alike. Only a core of backbench Liberal MPs and other interested parties were concerned about Britain's loss of industrial supremacy. The apathetic stance was supported due perhaps to the reliance on imperial preference in British foreign trade and the belief in the assumed sustainability of the Empire and the protected market as well as the complacent belief in the concept of the 'practical man'. This prevailing culture resulted in a resistance to the adoption of new technology, a point made previously (Cooper, 1984).

The absence of any graduate or post-graduate educational facilities in Britain to promote business, engineering and management training blunted the competitiveness of British industry. Chandler comments that: "As a result, the educational infrastructure so essential to sustaining modern industry appeared much later in Britain than in the United States or Germany" (1996: 293).

Where there were apparent successes in British industrial competition, particularly in chemicals (including explosives), electrical equipment and copper, British entrepreneurship still failed to sustain this initial competitiveness. British scientists were as good as those of Germany and America, but what was absent was the entrepreneurial and managerial spirit. Chandler commented that:

"Whatever the exact reason for such entrepreneurial failure were, two points are clear. First entrepreneurial failure in the new industries can be precisely defined. It was the failure to make a three-pronged investment in *production, distribution and management* essential to exploit economies of scale and scope. Second, the time-period in which that investment could have been made was short. Once the first movers from other nations had entered the British market often supplementing their marketing organisations by direct investment in production, the window of opportunity was closed." (Chandler, 1996: 286)

Singleton, in his paper on tank production during the First World War, stated that:

"Railway locomotives, rolling stock, steam engines, agricultural machinery, armaments, textile machinery and heavy machine tools were the core products of the British engineering industry. On the eve of the First World War, Britain possessed significant productive capacity of the newer branches of engineering such as the manufacture of motor vehicles, bicycles and electrical machinery." (1998: 91-2)

In his assessment, Singleton notes that:

"The attempts of economic historians to assess the health of the engineering industry, in the early twentieth century, have been hampered by the sector's diversity. Ground was certainly being lost in established export lines, to American and German competitors before 1914." (Singleton, 1998: 92)

The context of British cultural attitudes towards corporatism and entrepreneurship was the reason for almost a non-committal to efficiency tools such as cost accounting. As cost accounting is closely correlated to departmental accounting, its development in American corporate enterprise is clearly evident. The failure of British industry to adopt cost accounting techniques on a large scale is the result of these structural differences. Thus the growth of the contemporary accountancy profession in Britain from 1850 onwards did nothing to enhance the expansion of cost accountancy or other management accounting tools in Britain (Jones, 1981: 115), but a different story emerged from the Ordnance Factories from 1855 onwards.

From practical man to the professional ideal

The process of industrialisation in some way had an influence on the transition of the gentleman and gifted amateur during the eighteenth century, to service and profession during the nineteenth century. Perhaps the industrialisation concept also put a vulgarity on the notion of professionalism, identifying it as a form of labour, albeit labour of a superior kind. In some respects the rising professions during the nineteenth century were similar to the notion of tradesmen of the preceding centuries who had risen through an equally mystifying process from apprentice to master.

The consequences of industrialisation made its mark on the professional relationship. Indeed, the traditional bonds between the professions and landed classes began to be loosened during the nineteenth century. The traditional patron / professional relationship of eighteenth century English social culture tended to be dependent upon aristocratic custom and patronage and was now being replaced by a client / professional relationship.

As the nineteenth century progressed, the demand for professional services increased, due to the following reasons:

- The shift towards a servile state, particularly from 1900.
- The shift towards meritocracy. This is evident from the reforms of both the university examination system and the Civil Service, from the 1834 Graham Naval Reforms.
- The legal acceptance of the divorce of capital ownership from control and the concept of limited liability from 1855. This caused a demand for professional business managers and independent consultants. Although this was more evident in America from the 1830s with the development of the 'modern

business enterprise', the demand for professional business managers began to emerge in Britain from the 1840s but for other reasons. Most in the form of public accountants were exclusively engaged in floatation, winding up, bankruptcy and, later, auditing.

- This gave rise to a number of new quasi-professionals, for example land agents and public accountants, which occurred prior to the establishment of any professional accounting body. In a number of cases the public accountant also fulfilled other roles including that of land agent and country banker (Jones, 1981: 29).

Lloyd (1924), writing on the nineteenth century reforms in Army administration, suggests that public and private moral standards increased throughout the century. Lloyd concludes that the stabilising of the English banking system and the influences of interested groups within society, particularly quasi-religious groups, was the catalyst behind the improvement of moral standards in nineteenth century society (1924: 16). The influence of quasi-religious groups did affect the commercial and banking communities. The concept of the web of credit within the private sector generally and high trust culture (Wilson, 1995: 25).

Within the public sector the Crimean War was perhaps influential in the contemporary administrative reforms within the British Army. The work of William Russell as War Correspondent to the *Times* (the first in the field) reported and published the inefficiencies of the British Army in the field. The media began to play an important part in informing a better educated British public which in itself began the process of influencing the professional conduct of public officials.

By the mid-nineteenth century the Victorian public wanted 'value for money',

especially in respect of the Army and Navy, which reflected an anathema to Victorian democratic society. The Victorian taxpayer was now a stakeholder in the public life of Britain, which is evident from the pressure to set up the Northcote-Trevelyan Inquiry, despite the earlier reforms in the civil service.

The establishment of this inquiry into the Home Civil Service and its report to the Organisation of the Civil Service in 1853 was influenced by public opinion, despite the previous reforms, who were alarmed at the rise in public expenditure and the conduct of certain public officials.

The major objective of the Northcote-Trevelyan Report was to distinguish between the division of labour within the Civil Service, between the political and administrative civil service work and establish a distinction between 'intellectual' and 'mechanical' tasks. Certain government departments deployed double-entry accounting systems before 1853, notably the Admiralty, Ordnance Department and the Office of Woods and Estates. There was no overall uniformity, however; most departments practised single-entry cash-based accounting systems only.

The administrative class was established through the Civil Service Commission in 1855. During the 1860s some development regarding open competition was introduced. The post-1855 Civil Service accepted the concepts of "expertise, ability, economy, efficiency and effectiveness" and that recruits, or those aspiring to promotion, now had to rely on examination or open competition rather than through patronage (Ryan, 1972). The reforms did not amount to open competition until the Gladstone Reforms of 1870 however. Although the reformed Civil Service, like the previous 'unreformed' model, had its own internal professional route which was closed around a well constructed expertise of administration or knowledge, which was self

regulating and was vested within the objects of government on which liberal rule depended (Osborne, 1994: 289-313).

These reforms permeated into Victorian public life due to the increase within the democratic process throughout the century. Although universal suffrage was not attained in Britain until the twentieth century, many nineteenth century public sector institutions were established under the control of locally elected bodies with authority to spend public funds, for example the Municipal Corporations Act 1835, Poor Law Amendment Act 1834, and the School Boards under the Elementary Education Act 1870 with the authority to raise penny rates in order to fund local school boards. The creation of these local, if somewhat piecemeal bodies throughout the nineteenth century also increased the desire for professional rules set by professional bodies. For example, the public audit provisions of the 1835 Municipal Corporation Act statutorily provided the requirement to keep and formalise accounts. The onset of the 1834 and 1844 Poor Law Amendments Acts provided similar requirements. In order to protect the municipal and poor law ratepayer, district auditors were appointed with full powers to examine, audit, allow or disallow of accounts.

No powers or duties were attached to either municipal or poor law district auditors except that accounts were to be submitted to them and the auditor was to sign them if found correct. This concept was little different from the audit requirements of limited liability companies after the 1856 and 1862 Joint Stock Companies Act. Indeed the procedure of audit of municipal accounts remained thus in some boroughs until 1972. The lack of statutory regulation assigning the correct duties of a district auditor meant that there was a freedom to audit a diverse form of accounts. For example in most cases, borough treasurers were also not guided by detailed statutory

provision. This gap gave rise to district auditors and borough treasurers developing their own expertise in local government financing and to form a professional body in order to standardise procedures. Hence the Institute of Municipal Treasurers and Accountants was formed which later became the CIPFA in 1959. Other local accountants and treasurers joined the Society of Incorporated Accountants and Auditors on its formation in 1885. The establishment of the Society was not regarded with any equanimity by the Institute. On the contrary, the Institute of Chartered Accountants regarded its rivals as an outcast, full of schoolboard clerks, overseers and others (Stacey, 1954: 28).

Local government professional bodies were formed at the turn of the century and include the Institute of Municipal Treasurer and Accountants (IMTA) which boasted of 154 members in 1900. Previously it was known as the Corporate Treasurers and Accountants Institute (CTAI), also founded in 1885. The CTAI was formed as "there being no Society or Union in existence for the furtherance of objects common to all municipal and other similar local financial officers" (quoted in Jones, 1997). The CTAI followed the professional route by establishing its own journal, the *Financial Circular*, in 1896 and drew up its own procedures for membership and expulsion. In 1900 the CTAI unsuccessfully applied for a Royal Charter and was not to be granted this until 1959. In 1901 the CTAI was incorporated under the Companies Act and began to set its own examinations by 1903 (Sowerby, 1985). However, the CTAI was unable to secure a monopoly, its main rival being the Society of Incorporated Accountants and Auditors. The competition between the two bodies was partially resolved when the Society members were allowed to sit the IMTA final examination without being required to sit either the preliminary or intermediate

examinations (Garrett, 1961). However, very few public accountants were actually employed either in the Civil Service or the local authorities until relatively recently.

It is only since the Government White Paper *Better Use of Taxpayers' Money* (Cm 2929) of July 1995 that elements of commercial accounting are being introduced into central government (RAB). Resource accounting and budgeting is only part of a wider reform of the civil service under the Next Steps Initiative which includes the Private Finance Initiative (PFI). RAB and PFI reforms within the civil service now mean that government accounting has to comply with accepted accounting conventions common to the professional accounting bodies. This may open the way for more professional accountants to enter the civil service as a career option.

Conclusion

This chapter has focused on the soldier-technologist manager and this development as it evolved from America and, to a lesser extent, the British Army. This concept has been placed within a prevailing historical background of a growing professional élite. The experiences of Britain were quite small compared to developments in America, France and Germany. However, there were reforms which became more apparent after the Crimean War (1854-56).

The concept of British management still reflected the Practical Man approach although certain developments in the Ordnance Factories and possibly naval dockyards were reflecting a professionalisation of management, possibly from the eighteenth century. Pollard's intrusion into this over thirty years ago now needs to be reassessed in order to substantiate this.

The War Office generally from 1855 to 1914 had at its head some remarkably

good political secretaries of state, including Lord Panmure, Hugh Childers, H. Campbell-Bannerman and Haldane, and equally good civil servants including H.W.S. Whiffin, J.C. Hurst, L. Engelbach and C. Harris. However, the quality of the soldier-technologists, the superintendents and the civilian managers of the Ordnance Factories displayed a style of management which allowed production, technological development, efficiency and excellent labour relations to be undertaken at maximum efficiency with minimum disruption. This was at a time when Victorian liberal orthodoxy prevailed, with its suspicion of advances in the public sector or military expenditure. This allowed for the nucleus of professional management to develop.

In terms of this research, the next chapter examines the civil administration of the War Office, particularly in relation to Army accounts, and also gives an overview of the Ordnance Factories. This is important as most of the post-1855 accounting reforms of the Ordnance Factories were implemented by civil servants rather than by soldier-technologists.

The accounting reforms of the Ordnance, particularly of the Royal Arsenal, Woolwich (the Woolwich Departments) is explored in depth in Chapter 4.

APPENDIX TO CHAPTER 2

Cooper's Hill Calendar 1884-85

from India and Oriental Collection, British Library ST 1378

Obligatory course

Accounts

Third year

1. First Principles of Accounts

Single and double entry:

- limits of application of single entry accounts
- double entry
- nature of record
- meaning of terms Dr and Cr
- continued adjustment by means of
- limits of error possible in
- books of record needed for double entry accounts
- primary record ledger
- journal
- cash book, its relation to ledger and other accounts
- vouchers, different kinds of
- subsidiary ledgers, nature of
- balance sheets

Estimates and accounts

2. Mercantile Accounts

- books for bills payable and receivable
- invoices
- bills of lading
- warehouse and store accounts

3. Banking Accounts

- special features of, as compared with mercantile accounts

4. Government Accounts

- radical difference between government and mercantile accounts, the one based entirely on cash transactions occurring within fixed definite periods, the other upon liabilities and claims outstanding
- relations of government accounts to parliamentary appropriations
- exchequer credits and appropriation audit

5. Accounts of Indian Public Works Department

- form of these accounts determined by two conditions: that expenditure is limited by annual grants, and that the department is a manufacturing agency
- system of annual appropriations
- comparison of Indian as compared with English system of annual grants: degree of latitude allowed to the engineers in the application of the funds at their disposal
- public works accounts: divisible into three main parts - original accounts of disburser, abstracted accounts of the responsible engineer, and final record in audit office
- accounts of disburser
- forms of cash account
- imprest and current accounts
- nature of voucher required as evidence of payment
- work accounts
- various modes of economising labour and space in recording results
- contractors' accounts
- different cases of contract work
- labour only by contract
- labour and materials both contracted for
- work done by various contractors
- work done by one contractor only
- simplest mode of recording these transactions
- store and manufacture accounts
- mode of charging stores consumed against the works on which they have been used
- compendious modes for abbreviating labour in striking balances
- mode of checking balances
- store-taking
- accounts of the engineer
- mode of abstracting transactions of his subordinate disbursers
- mode of dealing with stores
- transfer accounts with other officers and departments
- divisional abstract of expenditure and receipts, the record on which the audit is based
- ledger and journal
- store ledger
- monthly balance sheet
- distinction between 'personal' and 'service' accounts
- accounts of audit office

- two main records
 - journal and ledger
 - difference between journal of executive engineer and that of audit office
 - journal used in Public Works Department: its special features
 - principle which underlies all good accounting, that the process of abstraction and condensation should be continuous throughout the books
-
- accounts of an Indian province
 - annual appropriation account
 - accounts of the Indian Empire
 - mode of compiling them
6. Accounts of railway and irrigation works
- twofold conditions involved, since these partake of the character of both government and mercantile account: first, accounts of year must be based upon cash transactions occurring within it; second, profits must be recorded
7. Accounts of manufactories (the Indian Ordnance Factories)

CHAPTER 3

The War Office Army Accounts and an Overview of the Ordnance Factories

Introduction

Sir Charles Harris, the Assistant Financial Secretary to the War Office, stated, in a paper delivered to the Staff College in 1908, that "the administration of the British Army is probably more complicated than any other business in the world" (quoted by Hinchliffe, 1983: 68). The aim of this chapter is primarily to examine the creation and growth of the War Office from 1855 onwards. The financial function of the War Office was undertaken by the Accountant General's Department, also created in 1855. The Accountant General's Department survived until 1904 when it was superseded by the Army Accounts Department. This chapter also examines the Accountant General's Department and its relationship with the Ordnance Factories from 1855 onwards. Initially the finance and management control of the Ordnance Factories came under Section E (later Section 5) of the Accountant General's Department of the War Office.

This chapter also explores the complexities of Army accounting and audit, first from a macro-accounting level, which was probably the source of the comment made by Harris in 1908. At a micro-accounting level, the costing and accounting systems at the Ordnance Factories is first introduced in this chapter and continues into Chapter 4.

The research profile into business and management history has tended to neglect the overall contribution of the government manufacturing departments generally, a point made in Chapter 1. Hobsbawm (1974) outlined the importance of war in economic, technological and social innovation, both in the public and private sectors. He relates the expansion of the Royal Navy including the Admiralty dockyards and the Arsenal at Woolwich with the growth of the iron foundries such as the

Wilkinsons, the Walkers and the Carron Works and the innovations of Henry Ford. This is similar to the importance of the space/defence industry for the American economy.

Both Henry Maudsley, the pioneer of machine tools, and Marc Isambard Brunel, as has previously been mentioned, "remained closely bound up with naval contracts" (Hobsbawm, 1974: 50). Sir Marc Brunel was instrumental in installing a steam sawmill at the Royal Carriage Department which became operational in 1812.

The first steam engine to be used at the Royal Laboratory was installed in 1805 by Joseph Bramah. Hobsbawm also reminds the student of the period that the pioneering role of the government's own establishments must not be forgotten. The statement made by Harris highlights the size of the War Office, including the Ordnance Factories and British Army in comparison to the contemporary private sector in Britain.

The War Office underwent numerous reforms in the nineteenth century, which included reforms of the government manufacturing departments and administrative and financial reforms within the Army generally.

From 1855, the government manufacturing departments were taken over by the War Office. Each government factory was placed under the superintendence of a senior military officer, which supports the notion of the soldier-technologist in Britain. But this development was by no means as advanced as the soldier-technologist concept in contemporary America. There was no overall military or civilian overseeing director general or chief superintendent until 1887. This system caused inefficiencies, particularly relating to breakdown in communications between one factory and another, even though they were on the same site. For example, the Royal

Gun Factory failed to effectively communicate with the Royal Carriage Department over changes in the patterns of gun mountings.

From 1887 onwards, attempts were made to civilianise the superintendencies of each Ordnance Factory and in 1890 the first civilian Director General of Ordnance Factories (DGOF) was appointed. (The title was changed to Chief Superintendent of Ordnance Factories [CSOF] in 1900.) However, there was a mixture of both civilian and military superintendents until the end of the First World War.

The purpose of this chapter is to act as a prelude to subsequent chapters which examine the financial structures, management of production and industrial relations of the Ordnance Factories. In relation to the concept of Victorian liberalism, the idea of ordnance manufacture through a public sector manufactory is somewhat enigmatic, yet it was because of this anathema shown by Victorian liberalism towards military expenditure that the Ordnance Factories evolved very quickly during the nineteenth century into modern units of manufacture, using the factory system, costing and DEB, scientific management principles and flexible labour processes.

The reforms of the War Office in 1855

The War Office was reconstituted in 1855 as the War Department. The official title of War Office was introduced three years later. The War Office existed as a separate government spending department until the creation of a tri-service (MoD) in 1964.

The initial reforms of the War Office in 1855 may have been influenced by the earlier Graham Navy Reforms of 1834 although the 1855 War Office reforms went much further than the original Graham naval reforms. For example, the Army

Contracts Department was established in 1855 as part of the War Office reforms. The Admiralty had to wait until 1869 for a similar Navy Contracts Department to be incorporated within its bureaucracy. However, the Accountant General's Department at the War Office was modelled on the Accountant General's Department for the Navy formed twenty years earlier in 1835 as part of the Graham Naval reforms.

Prior to 1855 some fifteen separate departments were in some way concerned with the administration of the British Army. This included two major offices of state: the Commissariat Office, which was under the direct control of the Treasury (Funnell, 1990) and the Home Office which, until 1859, administered the part-time volunteers from the militia and yeomanry.

The new War Office also incorporated the duties of the original Board of Ordnance, the Board of General Offices and the Army Medical Department including the men of the Medical Staff Corps.

Before 1855 the original Secretary at War had an office of Army Accounts. Despite this title, the Army Accounts Office was not wholly responsible for the administration of Army finance and indeed the Ordnance Office maintained its own separate financial system. This culture tended to prevail after the formation of the War Office. Sykes (1864), in a paper to the Royal Statistical Society, commented that the "great functionaries of the Army" held their own budgets quite separate from those of the War Office. These were:

- The Inspector General of Engineers
- The Director of Works
- The Director of Ordnance
- The Commissary-General in Chief
- The Purveyor-in-Chief

This structure was the main reason why the system of Army Accounts which evolved

throughout the nineteenth century reflected the separation with the administration of votes within the War Office. This caused an array of administrative departments and a bureaucracy mirror-imaging the organisation of votes. This system may have been adopted for control and audit purposes. Funnell describes this system as a:

"... fragmentation of the administration with numerous departments for all practical purposes autonomous of each other and not tied together by a central co-ordinating committee, issuing their own plethora of regulations and operating their own systems of administration."
(Funnell, 1997: 20)

The principal officials of the War Department in 1858 were:

- The Secretary of State of War
- Two Under-secretaries of State
- The Assistant Under-secretary
- The Secretary for Military Correspondence

Personnel records for civil servants employed by the War Office during the nineteenth century now no longer exist. However, a valuable source of primary evidence in relation to this research has been the annual War Office staff directories. An almost complete set exists at the library of the PRO, Kew, London (reference books 355: 340 216 WOR). There are some missing volumes including the years 1870, 1886 to 1889 and, more notably, for the years 1915, 1916 and 1919. The War Office Staff Lists tend to be unique as they contain biographies of all the principal civil servants in the War Office and of those who have been superannuated. There does not appear to be a corresponding Admiralty Directory for the same period. The reasons why the War Office should produce an annual Directory and not the Admiralty are not known.

Part of the War Office reforms included the establishment of the Accountant General's Department and the Army Contracts Department. Much of the work of the former involved accounting and audit of the War Office departments, mainly on a cash basis. But the accounting systems of the Ordnance Factories from 1862 represented

accounting concepts such as resource, capital and accrual accounting. This is further explored in Chapter 4.

The Cardwell Army reforms 1868-1872

Edward Cardwell was appointed by Gladstone as Secretary of State for War in 1868. Cardwell had to juggle with Army reform without excessively increasing the annual Army estimate. This would have been unpopular with the Victorian taxpayer, who was mindful of excesses in maintaining a regular standing army and contrary to Gladstone's Liberal manifesto.

Cardwell instigated a number of measures which began to transform the system of the Army into an organisational structure that was to last well into the twentieth century. He attempted to curtail the powers of the Commander in Chief and, by the War Office Act of 1870, the two offices of Secretary of State and Commander in Chief were amalgamated into a single department under the control of the Secretary of State. Power was shared and the new structure created a dual system as follows:

- The Secretary of State for War remained solely in charge of supply and finance.
- However, the Commander in Chief controlled the internal administration of the Army and its efficiency in pursuance of military duties. (Harris, 1911: 69)

Cardwell also reorganised the system of Army administration including the method of management of financial procedures and procurement of the military through a Control Department. This department became the nucleus of the Army Pay Department (APD), formed eight years later in 1878. The APD undertook the paymaster function of the Army and for the first time Army paymasters became part

of a professionally orientated organisation which enhanced their military career prospects, role and efficiency (Hinchliffe, 1983; Black, 1995).

The macro-accounting level - Parliamentary accounting in relation to Army accounts and expenditure

Until 1688, the established revenues of the Crown were the absolute prerogative of the sovereign, as was the disposal of such revenues. After the 'Glorious Revolution' of 1688, Parliament began to appropriate grants for specific objects and passed annual votes for the Army, Navy and Ordnance. However, the charges of civil government were generally defrayed from the sovereign's fixed civil list and were not totally divorced from civil list expenditure until the reign of William IV (1830-37).

The monies voted on warlike expenditure were audited by the Commissioners for auditing the public accounts who:

"... were required not only to identify defects in existing arrangements but also to consider in what more expeditious and effectual and less expensive manner the services can in future be regulated and carried on for the benefit of the public." (Adams, 1986: 189)

Despite this system of auditing, it was not transparent as the Commissioners for Audit were "practically under the control of the Treasury, the Accounts being declared before and passed by that Department" (MUN 5/106/400/12: xviii).

Before the Crimean War (1854-56) the Army to a large extent was self-administering in times of peace. Arms and ammunition were provided in kind by the Ordnance office for both the Army and Navy alike, the necessary funding for this being voted outside the Army and Navy estimates. The colonel of each regiment clothed his men on an allowance per man. Food, forage and horses were supplied

through the internal economy of each regiment. The Commissaries of the Treasury only took responsibility for the Army in times of war.

An examination of the contributions of Army accounting reforms during the nineteenth century, together with the personalities behind them, is important when considering the origins and concepts which were to become the precursors of modern management accounting. The system of Army reform and professional public sector management may appear to be completely unrelated, but Victorian liberal society had developed historically to be suspicious of large standing armies filled with conscripts designed for aggressive policies with contemporary neighbours. The viewpoint of the Victorian liberal conscience was interpreted by Parliament to effectively control the Executive. Therefore the control of the Army by a democratic Parliament was linked through these financial controls. This unfortunately was accomplished at the expense of any military preparedness and efficiency. Parliamentary financial safeguards were obsessive by the mid-nineteenth century to ensure its constitutional supremacy. This precluded "concern for the needs of a well-prepared army. The consequences of this alienation were tragically demonstrated in the Crimean War of 1854-1856" (Funnell, 1990: 321).

There were external reforms of naval accounting from 1834 and these did influence later Army reforms, but the major emphasis for reform was the effects of the Crimean War. The reforms in the management of Army accounts from 1855 were attempts to reconcile military finances and constitutional fears. By the eve of the First World War this had evolved into a system of efficiency and economy, and a description of the influence of these reforms is now given.

Prior to the 1866 Exchequer and Audit Departments Act, the form of

appropriation audit for 1862 slightly changed existing procedures in relation to both the Army and the Navy. The 1862 audit provided that if a necessity arose for incurring expenditure not provided for under the normal vote appropriate, then under certain approved uses the Treasury could allow certain sums to be made from any surplus from the same department. Technically, this was contrary to the normal rules of virement which generally did not allow the transfer of credit between one civil vote and another.

The preparation of the Exchequer and Audit Departments Act was undertaken by Mr. H. Childers and Mr. W. Anderson of the Treasury. Childers, in 1869, became First Civil Lord of the Admiralty and later in 1880 was appointed as Secretary of State for War. He influenced part of the War Office reforms in the latter half of the nineteenth century. Anderson was a civil servant and instrumental earlier, in 1832 whilst at the Admiralty, in implementing the Graham naval reforms.

The major clause of the 1866 Act was to "inquire into the receipt, issue and audit of public monies in the Exchequer, the Pay Office and the Audit Department" (MUN 5/106/400/12 46476: xviii). Section 22 directed that a department charged with expenditure of a vote should prepare an appropriation account showing how the monies were spent.

Under the Exchequer and Audit Departments Act of 1866 the audit of civil accounts was required through the following heads:

- a) correct appropriation in relation to proper classification both as to vote and sub-head, as well as to year of charge;
- b) proof of payment;
- c) application to the purposes for which the grant was intended to provide;

- d) a test of arithmetical accuracy;
- e) an inquiry as to authority of expenditure (MUN 5/106/400/12 46476: xx).

During the post-Crimean period, the whole sphere of Army administration was reorganised and departmentalised. This included the reconstitution of the War Office in 1855. Money was provided by the public in separate votes for clothing, commissariat transport, weapons etc. Each vote covered the activities of a department, which was responsible for the Army both in times of peace and war. The major accounting department, the Accountant General's Department of the War Office supplied the financial specialisms of the Army for Parliament. All these departments came under the authority of the Secretary of State for War (Report of the Committee for Army Expenditure, Cmd 2073, 1924).

The Army accounts submitted to Parliament were technically a cash statement only. The Army accounts showed monies received by the Parliamentary vote and how it was expended on Army balances. Harris did however refer to one criticism of the system of appropriation accounts by suggesting that "you can arrange or classify expenditure in two ways - according to its nature or according to its purpose" (Harris, 1911: 63). He commented that the Army estimates:

"... are arranged according to the nature of expenditure without reference to its purpose, so that our accounts, which follow the arrangement of the Estimates, do not show the cost of any service, department or branch of the army, or any other result of which the mind can lay hold as throwing light upon the economic merits of army administration." (Harris, 1911: 64)

The influence of Harris on the later cost accounting experiments in the British Army is crucial. The experiment itself reconciled the purpose and nature of Army expenditure.

The system of Army accounts along with other government accounts only

accounted for subjects rather than objects. The cash statement of Army accounts only showed monies received by the Parliamentary vote, and how it was expended by its proper vote head. Any surplus was returned to the Treasury, a point made by numerous witnesses to the Morley Committee of Inquiry in 1887 (C 5116).

The system of Army accounting was criticised as being unimaginative, "as to render criticism almost impracticable" (*The Balance*, 1924, vol.3, no.3: 100-1). The total once sanctioned by Parliament became almost a fixed annual figure which could only be varied under the Monk resolution in times of emergency. This resolution was passed by the Commons on 4 March 1879 on a motion put forward by Mr. Monk MP (MUN 5/106/400/12; Higgs, 1914: 73). The 1924 Report on Army Expenditure (the Lawrence Report) noted that:

"It is to this conception of the 'nursing' of the fighting army by the departments that the pre-war [1914] arrangements of Army estimates in fifteen separate votes corresponded. The different votes defined the provinces of different departmental directors in the War Office [formed in 1904 under the recommendation of the Esher Report] grouped under the several members of the [Army] Council who, through the Directors [of the varying departments], administered the respective votes, i.e. drafted the estimates for them and when the expenditure should proceed and initiated the necessary action. The priority of rival schemes of expenditure with reference to the total fixed for the Army Estimates as a whole was decided by the military members of the Council in Estimate Committee; but that once done, and the Estimates approved, the administration of the vote for a particular 'subject' (clothing, stores, works etc.) lay with the member of Council concerned as a departmental head, and with his directors." (Cmd 2073, 1924: 6)

The fragmented and departmentalised establishments within the War Office, as previously described, caused the system to fail when the Army was deployed in the field in an operational role. This had been one of the major difficulties experienced in the Crimean War. Although there were initial improvements during the post-Crimean War period, the system showed signs of failure again during the first

and second Anglo-Boer wars, in 1881 and 1899-1902.

Army accounts came under the provisions of the 1866 Exchequer and Audit Act 1876 but the Comptroller and Auditor General (CAG) audit of Army accounts was not by an item-by-item audit "but rather continued the policy of a test audit followed previously by the Board of Audit" (Funnell, 1997: 19). The CAG could select any item, votes or sub-votes to audit but had to cover all votes over a six-year period (Funnell, 1997: 19). During the financial year 1877-8 the system of test audit in the Army was extended to the Navy (MUN 5/106/400/12).

Other detailed test examinations were made on a selected proportion of both the Navy and Army revenue accounts. The CAG audit of the receipts of revenue on the following accounts was governed by s.33 of the 1866 Act, the 1889 Army and Navy Audit Act and delegated Treasury powers.

- The test and audit of stores accounts by Treasury minute of 15 November 1886 (Public Accounts Committee Report, 1887: 206).
- The test and audit of manufacturing and expenses account of the Army and Navy under the 1889 Act.

The 1866 Act required accounting officers approved by the Treasury to be on the establishment of each government department, to audit and approve the expenditure of each department and to superintend the compilation of the annual balance sheet for Parliament. Indeed, it would appear that the imposition of a Treasury-appointed accounting officer may have sought to impose a "regime of truth on ministries" (Foucault, 1980: 133).

The Accounting Officer at the War Office from 1855 to 1903 was the Accountant General and from 1904 to 1908 the Director-General of Army Finance,

retitled from 1908 as the Assistant Financial Secretary, a post held from 1908 to 1924 by Sir Charles Harris.

It was the business of the Accounting Officer to superintend, scrutinise and sign the annual appropriation account, the same Treasury minute stating that:

"technical knowledge of accounts is not necessary to enable the representative of the department ... to discharge himself of the responsibility which his signature implies"

but

"My Lords expect that accounting officers will take precautions to secure the recovery and bringing to account at proper times of all extra and other receipts connected with the votes under their control."
(MUN 5/104/400/24)

The challenge to the subject-based system of Army accounts came from Harris, who argued for the accounting of objects rather than subjects in order to enhance the efficiency and economy of Army expenditure and audit. In evidence before the Select Committee on National Expenditure 1908 (the Dawkins Committee), Harris criticised the existing system, arguing that it was:

"... so rudimentary that no even moderately complicated modern commercial business ... could be conducted successfully without something further, something that would classify and exhibit the expenditure according to the purposes for which it is incurred, distinguished between 'capital' and 'maintenance', between the working expenses of the different branches of the organisation and so on, something that would supply at least some general test of the economic efficiency of the concern such (e.g.) as the train-mile unit in railway management." (Quoted by Hinchliffe, 1983: 68)

The system of 'object' accounting, as defined in the Seventh Report of National Expenditure of 1918, became part of the nucleus of the short-lived cost accounting experiment of the British Army. This point was not mentioned by Funnell in his paper of 1997. However, Funnell is correct in suggesting that the outright reforms of the system of Army accounting and audit did not occur permanently, at least in part, until

the last two decades of the twentieth century (Funnell, 1997: 21).

The concept of object accounting may have been part of the experience of Harris when he was Auditor of Factory Accounts (Ordnance Factories) from 1894 to 1904 within the Accountant-General's Department when he was the Head of Section 5. This is a theme which is referred to later in this thesis.

The micro-accounting level: a resumé of accounting and cost accounting in the Ordnance Factories

The accounting and management reforms of the Ordnance Factories during the 1860s were modelled on similar reforms within the Admiralty dockyards and shipyards some thirty years earlier. It is perhaps pertinent at this point to introduce the accounting, costing and audit system of the Ordnance Factories in the nineteenth century in order to appreciate the emergence of a professional management ethos. This must be assessed against the problems and failings of the overall structure of Army accounts, as previously described. The internal reforms of the accounting systems of the Ordnance Factories are important, as it was only in 1995 that the then Conservative Government reintroduced these measures to encompass all government departments (Cm 2929, July 1995). This included RAB, which in essence includes resource budgeting, capital accounting and DEB.

Harris commented that:

"Only in one army department are there anything that a businessman would call accounts kept, and the difference between such accounts and Parliamentary Appropriation Accounts is well shown." (Harris, 1911: 64)

Here, Harris was referring to the accounts of the Ordnance Factories which, since the earlier reforms of 1862, had included:

- The Number 2 Balance Sheet which displayed depreciation of assets and buildings.
- The introduction of Capital Accounts in 1862.
- The introduction of DEB in 1864.

The system was working very satisfactorily and a favourable report was given by Lord Randolph Churchill's Select Committee Report on the Army estimates for the year 1887-8.

Harris commented in 1907 that:

"the Appropriation Account for the factories merely tells you that a million odd was spent on wages and a million odd on materials... The manufacturing or business account tells you in detail all the stores produced, with the cost price of each; so that you can see that your new field gun costs so much and its carriage so much, and can judge on the one hand whether your contractors are charging you a fair price for the same thing, and on the other whether your gun factory is being economically run." (Harris, 1911: 64-5)

The Army and Navy Act of 1889 had statutorily introduced another class of accounts under the review and scrutiny of the Public Accounts Committee (PAC). These included the manufacturing (or business) accounts of the Army, these being for the Ordnance Factories, and for the Navy, which were the Admiralty-owned naval shipbuilding yards. Also, the expense accounts were presented to the PAC. These included wages, purchases of materials and contract accounts.

The scrutiny of Navy expense accounts was to show how the costs of labour, materials and contract work had been converted into ships. The technology of warships was increasing and a particular design could be outdated in fifteen years. Costings at the Royal Dockyards were very successful. Ashworth stated that:

"The steel plates used in building warships at the end of the nineteenth century cost only a quarter as much as the iron plates used twenty years earlier... The reduction was from £20 per ton to £5 per ton and

cheaper steel plates were 20 per cent to 30 per cent stronger than the best iron plates formerly used." (Ashworth, 1969: 495 and footnote 3)

Ashworth suggested that "technological influences were not wholly biased towards costliness" (Ashworth, 1969: 495).

A similar system developed within the Ordnance Factories. The accounts could show conversion of expenses into field guns and the increase in ordnance technology was compatible with cost effectiveness. The accounts themselves showed the progress made with say each ship or field gun under construction, compared with a programme of estimated progress appended to the estimates set before the PAC. Again, the accounts also showed the cost of completed ships or field guns, constructed at government shipyards or at the Royal Gun Factory, as compared with those completed under contract at private yards or ordnance companies. Ashworth comments that a fair proportion of the warship repair and construction work in the UK until the end of the nineteenth century was completed in the Royal Dockyards. It was only in the years of sudden expansion, "e.g. 1877-78, 1878-79, 1885-86, 1886-87, did expenditure on contract-built ships exceed that on dockyard-built ships" (Ashworth, 1969: 492). There is also evidence to suggest that here may have been the beginnings of scientific management as a voucher system was recorded for all expenditure on each order and the employment of what Loft termed cost clerks to implement the voucher system (1994: 118). This voucher system began in the Ordnance Factories after 1862. The voucher scheme and the increased use of clerical staff to administer the system may be evidence that a system of scientific management was developing (see Braverman, 1998, chapter 15: 203-47). This point is further explored later. In the Ordnance Factories and Admiralty dockyards these cost clerks were called mechanical

writers.

A similar system also evolved in America, where Metcalfe employed what he called a "shop-order system of accounts" which made it possible to control the flow and improve basic cost accounting (Chandler, 1977: 273). The development of scientific management principles is an important concept which links the accounting reforms to other reforms within the Ordnance Factories, including production techniques and labour flexibility. The method of voucher recording in the Ordnance Factories is explained in more detail later.

The manufacturing accounts of the Ordnance Factories and the Royal Dockyards were subject to a test audit by the CAG from 1888. This was conducted with the same objective of accuracy of the accounts and in a proper format in order that, from the completed accounts, actual expenditure is exposed in "the conformity with the programme for which Parliament had provided the funds". This policy was incorporated into the 1889 Army and Navy Audit Act (Ashworth, 1969: 500, footnote 5). The success of the 1889 Act allowed for its influence to increase over other areas of government manufacture, including prison manufacture (MUN/5/106/400/1246476: xxi). The major statutes of the 1889 Army and Navy Audit Act were incorporated into the 1921 Exchequer and Audit (Amendment) Act.

Macro-accounting reforms versus micro-accounting reforms

In 1890 the appropriation account of Ordnance Factories was altered under the auspices of the 1889 Army and Navy Audit Act. The vote for Ordnance Factories was presented to the Public Accounts Committee for the first time, on the recommendations of the Morley Report 1889 (C 5116). The vote of the Ordnance

Factories was separated from the Army vote generally and became Vote 9.

Until 1886-7 the Army votes had provided for the pay of the establishment of the Ordnance Factories and for the full cost of land and sea armaments. From 1890 the votes for sea armaments were transferred to the Navy. The costs of the Ordnance Factories were met by the advancement of monies from the War Office, the Admiralty and other customers, for example the Indian Government, against orders. Any final adjustments were made on completion of the work.

Reforms as recommended by the Morley Committee of 1887 (C 5116) were mainly concerned with micro-accounting within the Ordnance Factories. These reforms included improvements on existing cost accounting in relation to labour costs. Prior to Morley, these costs were based on the records maintained by a staff of "work-takers". Each Ordnance Factory had its own variation and structure, with remuneration varying between each department in respect of the same class of labour. One department levelled charges against another to account for its own mistakes and so on.

The post-Morley reforms centralised the work-takers and their records. Stores accounts too were centralised. By this system a reliable account was secured on work completed and wages paid. Depreciation on machinery, cost of repairs, engine power and other current expenditure on plant was charged to indirect expenditure and ultimately distributed as a percentage on wages debited to orders in the cost ledgers.

After the second Anglo-Boer War (1899-1902), there were increased costs due to the expenditure of the war. These costs were borne by the public and were still rebounding within the Army vote in 1914. The Ordnance Factories had always maintained a reserve production capacity in order to meet the unexpected needs of

maintaining the Army in the field in an operational capacity. After 1903 there were growing criticisms about the expenditure made in maintaining this idle but necessary reserve production capacity at all. In any comparison between the Ordnance Factories and the private sector, this reserve production capacity always reflected a form of negative equity to the apparent detriment of the government factories. The government from 1904 began to favour procurement from the private sector for the Army. Companies such as Armstrong-Whitworth began to expand through this encouragement, opening the Coventry Ordnance Works in 1906 (Warren, 1998: 140).

A committee chaired by the Chief Superintendent of the Ordnance Factories (CSOF), H.F. Donaldson, deliberated between 1901 and 1902 in order to consider the costing system of the Ordnance Factories. The Donaldson Committee employed the expertise of a professional accountant (Morland) to assess the existing system.¹ Although Morland was generally happy with the existing costing system of the Ordnance Factories, he was less than happy with the costs required to maintain an almost idle reserve production capacity, i.e. fixed and variable costs. The calculation of the costs needed to maintain the reserve production capacity, proved to be

¹ Harold F. Morland (1869-1939) was a brilliant Cambridge mathematician and a devout non-conformist of Quaker persuasion. Morland became a partner in Price Waterhouse. Morland's eventual career was marred due to his involvement in the Royal Mail Steamship case (*R v Kysant and others*). Lord Kysant was chairman of the Royal Mail Steamship Company and Morland was the appointed company auditor. Both were charged under the 1861 Larceny Act with misleading shareholders as to the true state of the company's financial position. Both Kysant and Morland knew that the Royal Mail line's trading position had been performing badly since 1921. Kysant had been transferring large sums from undisclosed internal reserves in order to pay acceptable dividends. This was done with the connivance of the auditor Morland. Although both were acquitted, Kysant was further charged with issuing a false prospectus, for which he received twelve months' imprisonment (Jones, 1981: 151). (See also Jones, 1995: 153, 157 for a more detailed description of Morland's role in the case. Jones correctly refers to the inadequacies of the company legislation of 1907 and 1929 which was the major culprit of the *R v Kysant* case, rather than any criminal intent by Kysant or Morland. These defects in company audit were not remedied in part until the 1948 Companies Act.)

speculative rather than scientific.

The unique feature of maintaining the reserve production capacity was an expense borne by the Ordnance Factories and the Army estimates. No such reserve was maintained by the private ordnance factories. Indeed, this actually meant that no fixed percentage of difference of trade prices could be laid down between the Ordnance Factories and the private sector. The maintenance of the reserve production capacity in an idle state was unbusinesslike. However, Harris qualified his previous statement of the businesslike state of affairs of Army accounting by stressing that "the expenditure is a fact, while the efficiency (at any rate in peace time) must remain in large degree a matter of opinion, whereas war itself is unbusinesslike" (Harris, 1911: 60).

The army Ordnance Factories only supplied an internal market, supplying the Army, Navy, the India Office and the Government of Egypt, and the prices of the Army factories were published in the official publication, *Priced Vocabulary of Stores*. These prices were based and quoted mainly on the cost price of the Ordnance Factories.

The private munitions factories traded in a highly competitive, international and open market. The *Priced Vocabulary of Stores* was interpreted by the private armaments sector as representing the full and fair selling prices. This interpretation caused problems with certain armaments companies involved in the export of their products. The *Priced Vocabulary of Stores* did not stipulate that the prices reflected were cost prices, nor did the official literature explain that incorporated into the cost price was the cost of maintaining the reserve production capacity.

In assessing this problem, the Donaldson Committee agreed that the best

solution was to add a rider to the *Priced Vocabulary of Stores*, which was as follows:

"Prices shown in these accounts do not include rent on land, interest on capital or other trade charges." (*History of the Ministry of Munitions* (nd), vol.VIII, Part 1, Ch.1, p.19)

However, the PAC added to Donaldson's rather one-sided rider and included:

"... but on the other hand, include charges for depreciation and the upkeep of unused buildings and machinery maintained with a view to expansion, and cost of care and custody of stock stores." (*History of the Ministry of Munitions* (nd), vol.VIII, Part 1, Ch.1, p.19)

The official *History of the Ministry of Munitions*, written some twenty years later, fails to mention that the trade was prepared to use the *Priced Vocabulary of Stores* as a benchmark. In consideration of the eventual balanced-out rider incorporated into the *Priced Vocabulary of Stores*, the realities of the costing system of the Ordnance Factories became much clearer.

It would appear from the first part of the rider that the Ordnance Factories were at an unfair advantage compared to the private sector. Nevertheless, the second part of the rider, incorporated at the insistence of the PAC, reflects the original costing reforms from 1862. The Ordnance Factories had charged depreciation annually on their accounts since 1864, as will be shown in the next chapter. Many contemporary private sector organisations did not write off depreciation annually but only in times when trade was good. The PAC at least recognised the difference in the regular treatment of depreciation by the Ordnance Factories compared to the private sector.

The contemporary American attitude towards depreciation was equally as vague. Chandler referred to Oberlin Smith, the Chief Engineer of a New Jersey machine-tool company, and commented that "neither Smith nor his contemporaries made any attempt to account systematically for depreciation" (Chandler, 1977: 274). Indeed, the majority of American metal-working companies continued to adopt the

railroad method of renewal accounting and charged repairs and renewals to operating costs. Their assets were recorded either at original (historic) cost or as replacement cost (Chandler, 1977: 274). A similar method was adopted by railway companies in Britain, who used an accounting method known as the double account system of the capital account.

The inclusion of these riders into the *Priced Vocabulary of Stores* suggests that the previous inequalities were rather levelled out and, from 1903, the *Priced Vocabulary* offered similar comparisons with trade prices, but the reserve production capacity was removed from the Ordnance Factories between 1904 and 1914. This ultimately compounded the initial problems of munitions supply between 1914 and 1915 causing the alleged conspiracy of the 'shell scandal'. The shell scandal was the inability of both the Ordnance Factories and the private sector to supply adequate munitions during the first year of the First World War. The official *History of the Ministry of Munitions* does not mention the reduction of the reserve production capacity between 1904 and 1914.

Laissez-faire and its effect on the British social system

The concept of *laissez-faire* was a dominant social and political influence within nineteenth-century Britain. Taylor stated that:

"Nineteenth-century England may be said to have come closer to experiencing an age of *laissez-faire* than any other society in the last five hundred years... It was, until at least 1870, and arguably for a further twenty-five years beyond that, the strongest impulse influencing the shape and character of government policy." (Taylor, 1972: 64)

The basic tenet of *laissez-faire* was for the minimum state interference in the private affairs of the individual or private commercial concern. An early manifestation

of *laissez-faire* in British government was evident from the reforms of the Admiralty from 1834 onwards under Sir James Graham, as previously mentioned. Graham was a disciple of Benthamite philosophy. However, other reforms also occurring during the 1830s appeared to contradict the concept of *laissez-faire*. These included the government reforms of the Poor Law system under the influence of the civil servant Edwin Chadwick, and the giving of government grants to church elementary schools from 1833 onwards. Such reforms and later reforms throughout the nineteenth century created a government bureaucracy to administer the new systems.

Again, the state also interfered in the affairs of private industry and the apparent dilemma was more manifest, particularly in the state regulation of the railway companies and of banks. This was perhaps as a consequence of the crashes following 'Railway Mania' and the banking crises of the 1830s and 1840s. By the 1840s both industries were heavily regulated under statutory legislation. The increase in public companies during the first half of the nineteenth century resulted from 1855 onwards in step-by-step legislation which regulated the affairs to some degree of limited liability companies.²

The state in Victorian England and Wales did not provide resources for management education or training in the private sector, but a form of management education appeared in the curriculum of RMA Woolwich. It must be borne in mind, however, that neither the curriculum designers at RMA Woolwich nor the Victorian Army Officer, nor indeed the Victorian entrepreneur would understand the meaning of management. Braverman refers to Lockwood who, when writing on British clerical

² For a discussion on Victorian company legislation and its support or otherwise of the principles of *laissez-faire*, see Jones and Aiken [1995: 61-82], Walker [1996: 305-324] and Jones and Aiken [1999: 85-96].

labour, commented that: "Many of the clerks mentioned at the earlier period were probably performing duties which would nowadays be classified as managerial" (quoted by Braverman, 1998: 203). Lockwood also referred to the terms 'clerk' or 'chief clerk' in the contemporary sense of the eighteenth to mid-nineteenth centuries, which in many cases related to a managerial title in some "British industries, railways and public services" (quoted by Braverman, 1998: 203). The relationship of clerk or chief clerk to a management function in the eighteenth and nineteenth centuries reflected perhaps management in a functional rather than a strategic sense. As was explained in the previous chapter, the establishment of the Royal Indian Engineering College at Cooper's Hill in 1872 further expanded the provision of management leadership including accounting education in England.

Education in Victorian England was a "central arena for debate about the cultural values which shaped society" (Garnett, 2000: 210). Most state funding of education was bound up in religious issues and was targeted at elementary education. The state funding of elementary education had first begun in 1833 when grants were given to church schools of Anglican and nonconformist persuasions. Nevertheless, the protagonists of *laissez-faire* supported this system as it 'instructed' the working classes to accept their place in society, so fulfilling the original tenet of Benthamite utilitarianism, that being the greatest happiness of the greatest number.

The reforms of the British Ordnance Factories were influenced by economic liberalism, as had the previous Admiralty reforms, and also by the failure of logistical support for the Army during the Crimean War. The Victorian voter by the mid-nineteenth century was becoming more of a stakeholder in his society. Although the maintenance of a standing Regular Army and Royal Navy remained the total responsi-

bility of the state, the Treasury was far from generous in maintaining the armed services in times of relative peace. However, the Ordnance Factories were required to compete with the private sector from 1855 onwards for procurement for the Army and Navy.

Chandler (1990) identified the backwardness of British entrepreneurs as having much to do with the failure of the underlying social structures in Victorian society, particularly in education and management training. Unlike the contemporary military officers, British entrepreneurs lacked any formal management training, as was seen in Chapter 2. The effects of this backwardness were most felt from 1870 onwards.

From 1871 to the end of the nineteenth century the British economy underwent a downturn in the business cycle which has become known as the Great Depression. Traditional British industry was being overtaken by Europe (mainly France and Germany) and by America. This caused considerable alarm at the time. However, despite this concern, which led to a number of official enquiries into British industrial competitiveness, or the lack of it, little was actually achieved. The reason for this was possibly due to the belief in economic liberalism in its purist interpretation, and the belief in the notion of imperial preference with the British Empire and Colonies.

In respect of the Ordnance Factories, however, they flourished during the era of *laissez-faire*, particularly after 1855. The Army and Navy were not popular with contemporary Victorian society. The Ordnance Factories as public sector institutions were an anathema to the prevailing Victorian philosophy of economic liberalism. The Victorian taxpayer was not keen on financing a standing Army and Navy, nor the attendant Ordnance Factories or HM Dockyards, nor was the Treasury generous in financing the Army and Navy budget. Thus the Ordnance Factories, along with the

Admiralty dockyards, had to survive by their own merits and this they did very successfully.

Efficiency and economy, the government departments from 1855 and the increase in military technology

The emphasis of the paper delivered by Harris to the Staff College in November 1907 emphasised the efficiency concept of Army accounting generally (Harris, 1911). According to Harris, efficiency and economy of Army financial management compensated for the non-commercial concept associated with Army accounting generally (including the accounting and financial management of the Ordnance Factories). This concept was elaborated further by Captain Mark Synge of the Indian Army's Supply and Transport Corps. Synge identified efficiency and economy as reflecting the equivalent of profit in the private sector. He argued that:

"In a great many ways, the work of the Supply and Transport Corps is the work of a large business. We have to buy as cheaply as possible, and we have to store goods with care and economy, and we have to supply the good articles; we do not work for a profit, but we work for efficiency and economy. Efficiency and economy are to a government concern as profit is to a private concern. Hence we are businessmen working for what is analogous to a profit, and as such we are largely governed by the same rules of financial policy as are commercial firms. By learning how they finance their businesses we may learn to finance our own the better." (Synge, 1908: 1)

In relation to the hypothesis of this study and taking the efficiency and economy concept described by Synge, it is argued that it was the Ordnance Factories which were pioneering business management in the nineteenth century rather than the private sector. The concept of efficiency and economy was taken up again in 1914 by Young, previously referred to in Chapter 2, and in 1919 by Grimwood when arguing for costing for control in government departments. To elaborate further, a more detailed

analysis of accounting in relation to the Ordnance Factories will be given in the next chapter.

There were five major government manufacturing departments and two smaller satellite factories in 1855. Three government factories were situated at Woolwich and together were known as the Royal Arsenal. These were as follows:

- The Royal Laboratory founded in 1696.
- The Royal Brass Foundries, founded in 1716.
- The Royal Carriage Department, founded in 1803.

The Arsenal at Woolwich had been granted its Royal status in 1805 by George III (SUPP 5/1056). The origins of the Arsenal at Woolwich probably began during the time of Elizabeth I and were constructed on unoccupied land known as the 'Warren'. There is evidence from the Morley Inquiry of 1887 that the government were actually squatters on the site as the War Office never paid rent for the site of the Royal Arsenal. This point is explained more fully in chapter 4.

To the north of London, at Enfield Lock, was the Royal Small Arms Factory with two satellite factories in Birmingham, at Bagot Street, and Sparkbrook. The Royal Gunpowder Factory at Waltham Abbey also had its origins in Tudor times. There was also a government manufacturing department at Portsmouth until the late 1860s. The Royal Army Clothing Department was located at Pimlico, London. There were also the naval Ordnance Factories which were concerned with shipbuilding, ships' accessories, the production of victuals and equipment for sea supply. These came under the auspices of the Admiralty and, although more numerous than the Army Ordnance Factories, were smaller in size. A naval Ordnance Factory also existed at Woolwich until the First World War.

The War Office, on its formation in 1855, took over control of the government manufacturing departments from the original Board of Ordnance. However, during the preceding decade the government factories, particularly at the Royal Arsenal, Woolwich, had been updated and improved, notably under the supervision of a Scottish engineer, John Anderson (1814-1886). Anderson became a principal figure in the reforms of the government manufacturing departments during the nineteenth century. After a period as a boy clerk, Anderson was apprenticed to the same cotton mill in Aberdeen and attended classes at the local Mechanics Institute. This experience stimulated his interest in machinery. After seven years, Anderson moved first to Manchester with Messrs. Fairburn and eventually arrived in London working for Mr. Napier. Whilst in Napier's employ, Anderson assisted in the design and construction of a steam hammer at the Royal Brass Foundries within the Royal Arsenal, Woolwich. However, the civilian clerical establishment of the government manufacturing departments appeared to be second-class in status compared with the staff at the War Office headquarters in London, and other Army and Admiralty establishments. There was no interchange between the staff of various War Office and Admiralty establishments until 1879.

From 1855, military superintendents were appointed to each government factory and this continued until the last decade of the nineteenth century. The military superintendents were mainly senior officers of the Royal Artillery, though officers from the Royal Engineers were sometimes appointed as were, occasionally, naval officers.

The exception to this was the appointment of William Armstrong to the post of Superintendent of the Royal Gun Factory in 1859. Armstrong had been

instrumental in inventing a rifled barred field gun and assigned the patent to the War Office, according to Wilcox (1999) out of patriotism. In return he was appointed at a salary of £2,000 per annum plus £800 in travelling expenses, "his contract was made retrospective to 1856 as compensation for his past labours" (Wilcox, 1999: 58). Armstrong's appointment in 1859 was for a further seven years. Along with his civilian factory manager, Armstrong was instrumental in transforming the production of field artillery from a workshop orientated Royal Brass Foundry to a factory system within a relatively short period, building on the earlier successes of Anderson.

From 1855 onwards the reorganisation of the Ordnance Factories involved the creation of a formal structure with line and staff management functions. The model established fitted well into the bureaucratic formal organisation run on the Weberian model, which is based on six principles of which three relate to the emerging structure of the Ordnance Factories from 1855. These were:

- "1. Fixed and official jurisdictional areas governed by rules.
2. Hierarchical office authority with higher ranks of officials supervising lower ranks.
3. Management based on written documents 'the files'. One unit of files and their officials comprise a 'bureau', known as an 'office' in the private sector." (Jeremy, 1998: 501, quoted from H.H. Gerth and C. Wright Mills (eds). From Max Weber, *Essays in Sociology*, 1948; reprint 1995; London, p.214)

However, the bureaucratisation of the Ordnance Factories continued after 1889 when, on the recommendation of the Morley Report, the command structure of the Ordnance Factories was centralised under a supreme Director General of Ordnance Factories (DGOF).

Other line management and staff posts were also reserved for military officers. The employment of military superintendents of the government manufacturing

departments reflects somewhat the concept of soldier-technologist as was apparent from America, particularly the US Ordnance Corps and the Corps of Engineers (Smith, 1987: 40; O'Connell, 1987).

Before 1865 the superintendents were employed for an indefinite period. However, from 1865 onwards the superintendents' tour of duty was restricted to five years, according to "the ordinary rules of Staff Service" (WO 33/34 - the Manufacturing Departments of the Army - Reorganisation of Clerical Establishment, 1879).

The cycle of transition of the military superintending staff of the government manufacturing departments placed the civilian principal clerks in a very important logistical position. Their role was similar to that of a company secretary in a limited company and they were required to assist the superintendent (equivalent to the Managing Director) "in all matters relating to the internal and financial economies of the factories" (WO 33/34: 6). They were responsible for all matters in relation to:

"the internal and financial economy of the factories ... and for the custody of stores and the correctness of the store accounts, and countersign all certificates for cash payments connected with the respective factories." (WO 33/34: 6)

The principal clerk for each factory was the custodian of the records of their respective establishment. Their permanence of position, together with their knowledge and experience of the organisation structure and both official and unofficial procedures of the government manufacturing departments, made their position especially valuable, particularly on a changeover of military establishments. The principal clerk appeared to be the influence behind the internal generated management systems in the Ordnance Factories rather than the military superintendent.

Until 1879 the principal clerks of the government manufacturing departments

were only equated to clerks on the War Office headquarters establishment. The Committee of 1879 recommended that their pay and conditions of service be improved commensurate with their duties, experience and knowledge, to be at least in parity with senior clerks on the War Office headquarters establishment. The 1879 Committee also recommended that clerks and writers at the government manufacturing departments should be able to interchange with other War Office and Admiralty departments, and the salaries of these clerks be the same as other London-based War Office clerks.

Despite this, the five-year cycle tended to cause some long-term management difficulties which were exposed during the Morley Inquiry of 1887-8. Morley recommended that these posts should be civilianised to ensure continuity of management. The evidence behind this recommendation came primarily from Lewis W. Engelbach, who was Principal Clerk to the Director of Artillery at Woolwich. Engelbach was a member of the 1879 Committee investigating the reorganisation of the clerical establishment of Army factories. Engelbach later became Assistant Accountant-General at the War Office in 1888.

The Crimean War (1854-6) had witnessed the failure of British smooth-bore artillery made of traditional brass at the siege of Sebastopol in the wake of the superior allied French rifled artillery. The British guns were heavy, difficult to position and prone to damaged vents after modest firing. The War Office sought advice on artillery improvement which arrived in the form of the Armstrong gun in 1860. The Armstrong gun was lighter, had more manoeuvrability than the previous heavy guns though having the same firepower. The Armstrong gun proved its worth in its first baptism of fire during the second China War of 1860.

The Armstrong gun was made of iron coils joined together through forging. Initially, the process meant that the partly constructed gun had to pass through differing phases in various workshops until completed, which was a waste of both resources and manpower.

This problem was resolved by the manager of the Royal Gun Factory, Robert Frazer (later Fraser) who:

"soon after ... [his] appointment to the machinery department, the Government adapted the gun and its manufacture introduced by Sir William Armstrong, which led to the transition of the Royal Gun Factories, from the comparatively small foundry and machine shop in Dial Square into the magnificent works of which the department now exists." (Proceedings of the Institution of Civil Engineers, vol.78, Part 4, 1883-4: 427)

Fraser adapted Armstrong's original gun where it could be constructed of a lighter steel rather than wrought iron, and comprise only of a few large component parts rather than several shorter parts. By this method Fraser reorganised the labour involved in the production of the Armstrong gun, where fewer component parts had to be transported between workshops (see Chapter 4). The modified gun bore Fraser's name and:

"combined with the employment of cheaper iron, a Fraser gun can be made more cheaply than [the Armstrong gun]... The 'Fraser' [gun] manufacture and construction has since pervaded the entire service and though steel is now superseding iron, the system of building the gun has not been materially changed." (Proceedings of the Institution of Civil Engineers, vol.78, Part 4, 1883-4: 429)

Fraser's reforms of the Armstrong gun meant that it could be produced through a process of interchangeability (see Chapter 4 in relation to the lower production costs of the Fraser gun).

The role of the government manufacturing departments was to supply munitions of war in the short term, whilst the private sector prepared to ratchet up its production

in order to fulfil any long-term demands made upon it in time of war. The period from 1856 to 1899, according to Trebilcock, involved a *laissez-faire* concept of wars. Trebilcock, quoting from the Esher Report on War Office reconstitution (Cd 1932, 1904), stated that:

"one immunity from stress when the provision of relatively small expeditionary forces to operate against unorganised and ill-armed peoples had been the principal occupation of the War Office." (quoted by Trebilcock, 1975: 141)

Further, Trebilcock suggests that:

"In such a context, a small coterie of professional armourers, working alongside the royal Ordnance Factories, could supply the nation's needs, and industrial mobilisation remained many battles distant" (1975: 141)

Both statements must be treated with caution. Esher had obviously not included the results of the two Anglo-Boer wars (1880-1 and 1899-02) in the statement made in his report of 1904. The Boers were hardly unorganised nor ill-armed. Indeed, the Natal Field Army under General Colley had been defeated in three engagements during the first Anglo-Boer War, resulting in the death of Colley, who was killed in action at Majuba Hill in February 1881. The result of this war led to the independence of two Boer republics, the Transvaal and the Orange Free State.

Despite the apparent 'gunboat' diplomacy and order of battle policy of the Victorian military high command from the cessation of the Crimean War in 1856, to the commencement of the second Anglo-Boer War in 1899, the ensuing decades saw an increase in both the technological sophistication and volume of military and naval weaponry.

The transformation of naval technology was influenced by events both in Europe and in America. In 1859, the French launched the first iron-clad battleship

with a 4½" thick iron-plated hull (Wilcox, 1999: 59), *La Gloria*, to be followed a year later by the British contribution in the form of *HMS Warrior*. The first naval battle in history between two iron-clad battleships occurred during the American Civil War (1861-64). The Union navy built *USS Monitor*, constructed of rigid flat iron plate, and her guns were mounted in an armoured revolving gun turret. The *Monitor* could engage fire without changing direction.

The Confederate Army controlled the Naval Yard, Norfolk, Virginia and rebuilt a former traditional battleship as an iron-clad ship. The *CSS Virginian*'s guns were traditionally placed in the hull of the ship so that she would have to alter course in order to engage fire. The *Virginian* broke the Union blockade, sinking two traditional wooden battleships. The *Monitor* and *Virginian* met in battle in the Hamden Roads off Norfolk. After four hours of battle, although inconclusive, the *Virginian* was forced back to Norfolk. She was scuttled by the Confederates prior to the taking of Norfolk by the Union Army.

The influence of this battle altered the course of naval warfare and, with the development of breech-loading rifled cannon and the metal-penetrating exploding shell, the European naval powers were transformed. For example, from 1860 to 1913 total gross expenditure of the UK government on Army and Navy ordnance increased enormously. Ashworth points to the fact that:

"Throughout the nineteenth century defence was one of the two largest items in government expenditure and, apart from transfer payments (of which debt charges were the main constituent), it was the largest item. Indeed, at least from 1885 it was the largest item on any sectioning. Expenditure on the Army and Ordnance regularly exceeded that on the Navy, but in the late nineteenth century it was the Navy that was causing much of the largest increases, and from 1896 onwards expenditure on the Navy (except during the [second Anglo] Boer War and its immediate aftermath) was always more than half the total defence expenditure." (Ashworth, 1969: 49)

	1860 (£m)	1885 (£m)	1895 (£m)	1896 (£m)	1913 (£m)
Total gross expenditure of UK government	69.6	88.5	100.9	105.1	184.0
Army and ordnance	14.1	18.6	17.9	18.5	28.1
Navy	10.8	11.4	17.5	19.7	44.4
Total defence expenditure	24.9	30.0	35.4	37.2	72.5
Debt charges	28.7	29.0	23.3	22.8	19.9

(B.R. Mitchell and Phyllis Deane, *Abstract of British Historical Statistics*. Cambridge, 1962, pp.397-8, quoted by Ashworth, 1969: 491)

In relation to reforms to British developments in respect of naval ordnance, G.W. Rendel presented a paper to the Institution of Civil Engineers in 1874 of such undertakings at the Elswick Ordnance Factory. This paper was published by the Institution in their minutes and describes the progress of mechanically adjustable gun carriages in order to elevate the gun, and of the development of mechanical loading naval ordnance. Rendel suggested that:

"A few years ago gun carriages were of the simplest character and, though well adapted to their purpose, were scarcely worthy of the attention of the Civil Engineer. But of late, owing to the increase in the size and power of ordnance since the introduction of armour, gun carriages have gradually become elaborate machines and the appliances for working the monster ordnance now in contemplation will tax all the resources of mechanical sciences." (Institution of Civil Engineers, *Minutes of Proceedings*, vol.38, 1873-74: 85-103 with plates 'Gun Carriages for Heavy Ordnance', G.W. Rendel)

The growth in the proportion of Navy to Army expenditure was slightly affected by the transfer of the cost of naval armament from the Army to the Navy vote from 1888, as recommended by the Morley Report of 1887 (C 5116). Prior to this, naval ordnance manufactured in the Army Ordnance Factories was borne by the Army vote.

Much of this military and naval technology encompassed numerous Victorian engineers. For example, George Wightwick Rendel (1832-1902) had been an engineer

in India constructing bridges for the East India Railway across the Ganges and Jumna rivers at Allahabad. In 1858 Rendel became a partner in the firm Sir William Armstrong & Co., later known as the Elswick Ordnance Company. Rendel was later appointed by the Admiralty in the design of iron-clad warships and in devising systems of hydraulic machinery for mounted guns for both the British and Italian navies (proceedings of minutes, Institution of Civil Engineers, vol.151, 1902-3).³

The emergence of a factory system

The development of the new military technology was both researched and manufactured at the government manufacturing departments. Indeed, Enock suggested that armament production began "to take on its modern aspect of complexity and specialisation" from this period (1923: 70, quoted by Trebilcock, 1975: 141). Despite the relatively low-key *laissez-faire* wars from 1856 to 1914, the government manufacturing departments emerged during the same period from a craft-orientated workshop environment representing inflexibility both in terms of production, craft skill demarcation and ritual, to one of interchangeability, factory production methods and flexible labour practices through piece-working on the basis of scientific management principles. The Ordnance Factories had a major advantage over the contemporary gun trade as they had a market which favoured long-run production processes coupled with efficiency and cost effectiveness. Also, the government manufacturing departments along with the Royal Dockyards became part of the 'Solomon's House' of innovation, science and technology.

³ For an appreciation of G.W. Rendel and the Rendel family in the history of Armstrongs of Elswick, see Warren, 1989, chapter 3: 18-20.

By comparison, the civil engineering industry appeared to be a long way behind the government manufacturing departments. Hinton refers to the attempts of nineteenth century engineers to:

"exercise control over various aspects of managerial prerogative - the types of machine used, the manning of machines in the context of their concern with the material rewards of work: 'control as a bulwark of wages'." (Hinton, 1973: 93)

Craft control was not only perceived in terms of monetary goals but also spiritual rewards. Hinton explains that:

"Craft controls had been built and tenaciously maintained not only in defence of material interest, but also as a means of resistance to the reduction of craft labour to commodity status. The craft worker always retained something of the creative psychology of the producer." (Hinton, 1973: 93-94)

There was a great division between the engineering craftsman and his labourer, despite the strength of:

"the craftsman's apparent acceptance of a bourgeois ideology of *laissez-faire*, self-help, his aspirations remained an implicit fundamental challenge to capitalist rationality. This is how the Engineers' Executive in the peaceful mid-1850s protested their innocence of any antagonism to the employers: 'It is not intended ... to damage their interests, but rather to advance them, by elevating the character of their workmen, and proportionately lessening their own responsibilities'." (Hinton, 1973: 94; Webb, 1920: 208)

An assessment of each of the great engineering lock-outs of 1851, 1897-98 and 1922 "was fought explicitly in defence of managerial prerogatives, seen by the employers as the front line of bourgeois hegemony" (Hinton, 1973: 94).

The increase in engineering technology was a potential to deskill craft work into "almost foolproof machine minding" (Hinton, 1973: 98). The increase in technology included new jigs and gauges, high speed steels from the 1890s made for more accurate cutting tools, "and speed and feed tables replaced the experienced

judgement of craftsmen" (Hinton, 1973: 98).

The craft engineering workshop in the private sector reflected the industrial economy of the nineteenth century generally, which "was highly fragmented, dominated by small units ... with a low level of integration between different stages of production... Most industrial firms had weak internal commercial hierarchies" (Daunton, 2000: 75-6). The major transition of the factory system and an integration of managerial hierarchies in the nineteenth century, particularly within engineering and manufacturing, can be seen with the post-1855 reforms of the Ordnance Factories, particularly with the Royal Small Arms Factory, Enfield from 1858. Prior to 1858 there had been a government workshop at Enfield with two satellite factories at Bagot Street, Birmingham and at Sparkbrook, which manufactured muskets and bayonets. The pattern of organisation and method of production changed after the Board of Ordnance Commission visit to the American Federal and private armories.

The Commission, with the approval of the Master General of Ordnance, Lord Raglan, purchased 57 milling machines at £60 each and 8 universal millers at £160 each, from Morris Robbins and Lawrence of Windsor, Vermont. Other machinery to the value of £7,500 was bought from the Arms Manufacturing Company of Chicopee, Massachusetts.

The Commission also engaged the services of J.H. Burton, Master Armourer, the Federal Armory, Harper's Ferry for the new Enfield factory. Burton's role would be to design the fixings and the tools required for the new system of production.

Molesworth recommended the building of a large new factory on the existing Enfield Lock site, previously used as a government factory for repairing muskets and manufacturing bayonets. The new Royal Small Arms Factory at Enfield would be

dedicated to small arms manufacture on the interchangeability production method.

In February 1855 Colonel (later Major General) Manley Dixon RA was gazetted Superintendent Royal Small Arms Factory at Enfield. Dixon was the first military officer so appointed to command a government manufacturing department. Dixon's appointment has some similarities to Roswell Lee's appointment as Superintendent of the Springfield Armory in Massachusetts some twenty years previously (Roe Smith, 1987: 48). Dixon was the officer of the Royal Artillery who had accompanied Gunner and Anderson to Manchester and Leeds the previous year. The manufacture of bayonets by a process of interchangeability at the Enfield workshop prior to 1855 was probable though this has not been confirmed or substantiated. The work of reconstruction of the Enfield site commenced during the latter part of 1854 and was completed in late 1857. The original outlay for the reconstruction of the Rifle Factory site was £202,880: this figure excluded the value of the original site adapted for manufacturing rather than, as previously, assembly. The sum expended on land, buildings, machinery and gas works amounted to £315,000. By 1862 this amount, together with £48,000 depreciation, had repaid itself by the reduced cost of production (Monsell, 1862: 576).

The rebuilding programme was under the management of Major General Collinson RE. The maximum output from the completed project was estimated to be 130,000 muskets and bayonets per annum. The Royal Small Arms Factory at Enfield Lock became both a laboratory and a factory, very similar to the Springfield Armory in Massachusetts.

In March 1893, in answer to a Parliamentary question, the Financial Secretary to the War Office stated that the expenditure of the Enfield factory, commencing from

1854, included £2,670 for land, £7,000 for a rifle range and, since 1854, £195,328 had been spent on buildings. Mr. Woodall, the Financial Secretary, clarified the situation by suggesting that during the period from 1854 until the present (1893), depreciation had "reduced the imputed value of the buildings". This was represented by a smaller figure representing the value of the buildings which was evident from the current annual balance sheet (*The Times*, 25 March 1893).

The introduction of interchangeability within the government manufacturing departments from 1855 altered the ethos of ordnance production. From 1855 onwards, production was now based on a factory system rather than a workshop system. There was a 'de-crafting' of labour and the method of payment was based on piece-rate working. This suggests that elements of cost accounting and scientific management principles were now being used within the government manufacturing departments: this is examined in more detail in later chapters.

There was also the incentive of competition to encourage cost accounting as the majority of Army procurement was tendered to the private sector. In particular, the private armaments manufacturers and cordite firms were very keen to procure Army contracts. Piece-rate working was an essential consideration in assessing the changes that took place after 1855. It points directly to elements of costing within the government manufacturing departments.

The American influence on small arms manufacture at the government factories did not stop in 1855. James McGee in 1886 was Manager at the Enfield Rifle Factory, a post he had held for seven months. Prior to this, McGee had been Assistant Manager for twelve years and had been with the Enfield factory for a total of twenty years. McGee gave evidence to the Morley Inquiry in 1886 (C 5116: 50-

In evidence to Morley, McGee stated that he went to the gun factories of America in 1868-9 on his own account and was employed as a workman at the Springfield Armory. McGee commented that the machinery employed at Enfield and at Springfield were almost of the same pattern. In his opinion, the average American workman in the Federal armories are given more encouragement to invent than they was the case in England. The American workman can obtain a patent quite cheaply "and is always rewarded by the management for any useful suggestion they make" (C 5116: 50).

McGee also commented that the "American workmen are steadier and more self-reliant than the English workmen". However, many of the workers at the Springfield Armory were Englishmen, especially the blacksmiths. McGee explained how a system of subcontracting operated in the Federal armories. The subcontractors employed about fifty men. A similar system at Enfield had failed although, in private gun manufacturing, a gunsmith at Bow and at Birmingham successfully used a subcontracting system. McGee stressed that the subcontracting system encourages talent in "the workmen and saves a number of foremen" (C 5116: 51, Summary of Evidence).

Subcontracting-in of labour was a common feature at the American Springfield Armory prior to 1861. However, the control management and production of the Springfield Armory perhaps did not reflect a factory system until the onset of the American Civil War. Under the superintendency of Colonel Alexander Dyer, the manufacturing systems were radically altered, in order to mass-produce in high volume the Springfield rifle-musket Mk1. By the time of the American Civil War, the labour

utilisation at the American Federal Armories had been

"... mechanised and divided ... individual work assignments became more simplified whilst the overall production process became more complex... Under these conditions the engineering of people assumed an importance equal to the engineering of materials." (Smith, 1987: 79)

Production methods at the Small Arms Factory, Enfield did not include the practice of subcontracting-in labour, nor of subcontracting-out work. Indeed, subcontracting was not a regular practice deployed by the Ordnance Factories until the First World War. This was a major reason for its development into a factory system after the introduction of interchangeability whereas, due to subcontracting, the Birmingham gunsmiths retained a workshop culture almost until the end of the nineteenth century. The factory system at Woolwich and Enfield may be reflected in the lack of militancy shown by the ASE membership at the Royal Arsenal during the First World War and could be a reason for the unique relationship between the trade unions and the War Office generally.

Writing in the immediate post-1918 era, Wolfe commented on the pre-1914 relationship as follows:

"But on the whole the Admiralty and the War Office, as the great employing Departments, were under little control except the general control of the Treasury and the Cabinet... The War Office again dealt separately with the problems at Woolwich Arsenal and Enfield Small Arms Factory. In matters of general labour policy, questions were decided not by reference to the Board of Trade or the Home Office, but by the decision of the Army Council. For example, in the vexed question like that of the recognition of a shop stewards' committee, which was destined to play a considerable part in the War ... so far as Woolwich Arsenal was concerned, by negotiating with a committee of that character in the Arsenal." (Wolfe, 1923: 11-12)

McGee also stated that, in his opinion, skilled labour prefers to inhabit towns rather than the country. At Enfield the labour was very unskilled. Most labour at

Enfield rented rather than bought their own homes. The labour force was migrant. McGee stated to the Morley Inquiry that: "When trade is slack at Sheffield and Birmingham skilled men come to the factory [Enfield] and leave it when trade revives" (C 5116: 51).

In 1907 Murray noted that the Government Rifle Factory at Sparkbrook, Birmingham had been recognised as surplus to requirements. A previous committee in 1905, chaired by Mr. Bromley Davenport, later Financial Secretary to the War Office, placed the Birmingham factory on reserve. By 1907 the Birmingham site was sold to the Birmingham Small Arms Factory (BSA). As a condition of the contract, BSA was guaranteed to receive an order to produce part of the overall order for the short-muzzle Lee Enfield (SMLE) rifle. In return, BSA gave preference of employment to the original employees at the government factory at Sparkbrook, Birmingham.

Murray considered that the dual manufacture at Enfield and Sparkbrook, as hitherto carried on, had not been an economic advantage for the following reasons:

"There are obvious advantages, e.g. in the reduction of indirect charges to be obtained by concentrating the manufacture of similar articles in one factory provided, as in the present case, the resulting establishment does not become unwieldy; and we are confident that if Government were now beginning such manufacture de novo two separate factories would not be created." (Murray, Cd 3626, para.16, 1907)

The Birmingham factory only produced rifles, whereas at Enfield both rifle, sword and bayonet manufacture and rifle repairs were conducted. Enfield also produced machinery and machine tools as well as participation in research and development projects. The Birmingham Bagot Street factory also housed the Inspection Department. The Bagot Street factory was closed down in 1894 and production of the innovative new magazine-loading Lee Metford rifle was transferred to the

Sparkbrook factory along with the labour force (*The Times*, 20 February 1894).

Despite the government Small Arms Factory at Birmingham, with its close proximity to coal and iron supplies and a skilled labour force, Murray noted that the Enfield factory produced at less cost than the Sparkbrook factory in Birmingham. This difference had been observed in previous committees, notably the Molesworth Committee some sixty years previously.

Evidence given to the Murray Inquiry noted that:

"Taking the period of the fifteen years from 1889-90 to 1903-04, inclusive, we find that the average cost of rifle production at the two factories has been as follows, viz:

	£	s	d
Enfield	3	3	2
Birmingham	3	7	7-8
Showing a difference of		4	5

During the same period the average number of rifles manufactured annually at Enfield was 44,274 and at Sparkbrook 16,181." (Murray, Cd 3626, para.16, 1907)

Murray suggested that the disproportion in the volume of output explains the higher cost of production at Birmingham. The Committee also states that the Sparkbrook factory could not be enlarged whereas at Enfield enlargement was possible. However, Murray failed to explain more fully the higher costs of production at Birmingham. Despite the apparent advantages of economies of scale at the Sparkbrook factory in relation to its factors of production, notably coal and iron, its labour may have been the cause of the higher cost element compared with Enfield. Yet Murray had considered relocating the Royal Arsenal to a provincial town in order to avoid London prices. However, most of the Birmingham gun trade was still craft- and workshop-orientated, rather than flexible- or factory-orientated. This encouraged higher labour

costs. By 1904 most of the government Rifle Factory at Birmingham were recruiting labour from the local gun trade with its prevailing demarcation craft culture and subcontracting ethos.

There is evidence, given by McGee to the Morley Committee in 1887, to support this argument. McGee confirmed that wages at Enfield were slightly higher than at Sparkbrook "for the same class of man". However, McGee imagined that at Birmingham:

"You would more readily obtain men for a limited time than would be the case at Enfield. We could get men at Enfield for working the machines, unskilled labour - I have no doubt cheaper, or as cheap as you could at Birmingham - but not skilled labour." (Morley, C 5116, 1887: 379, question 7801)

In 1907 it was considered that the maximum number of men who could be employed at the Enfield Rifle Factory was about 3,500 and the minimum number 2,000 (Murray, Cd 3626, para.19, 1907).

Conclusion

This chapter has described the development of the War Office, the Accountant-General's Department and government manufacturing departments from 1855 to 1914 and the bureaucracy of the system of Army accounting and audit.

By the end of the nineteenth century, the government manufacturing departments had emerged from being workshop-structured manufacturing units to factory-producing manufactories. Much of this transition and reform resulted from internal rather than external influences, through engineers and civil servants employed by the War Office rather than through entrepreneurs or accountants. The nature of the Victorian Army, with its attendant Ordnance Factories within contemporary

society, was a major influence for its efficiency. In the main, the Ordnance Factories had to be efficient and to stand and fall by their own merits. They were successful in cultivating an efficient managerial ethos until the end of the second Anglo-Boer War in 1902. From 1904 to 1914, numerous Treasury dominated committees reduced the total efficiency of the Ordnance Factories in relation to finance and morale to a fraction of what it had been. Commentators writing on the inadequacies of industrial mobilisation in 1914 have always been ready to blame the Ordnance Factories for this (Lloyd George, 1938; Adams, 1978; Trebilcock, 1975; Loft, 1994) but the real culprit was the Treasury and the preference for naval shipbuilding at the Royal Dockyards. Elements included in this chapter will be further explored and elaborated upon in subsequent chapters, notably three concepts:

- i) Cost and financial management accounting (Chapter 4).
- ii) The production process through interchangeability (Chapter 5).
- iii) Scientific management, including labour relations (Chapters 6 and 7).

CHAPTER 4

Efficiency and Economy

and the Woolwich Department Accounts:

**The Management, Accounting and Costing System
of the Government Manufacturing Departments**

From 1862 to 1915

Introduction

The accounting reforms of the Ordnance Factories began some eight years after the conclusion of the Crimean War. Although there had been earlier and similar reforms within the Admiralty dockyards during the Graham naval reforms, some thirty years earlier, the architects of the Ordnance Factory accounting reforms had experienced the inadequacies of Army administration generally during the era of the Crimean War (1854-6). One of the principal architects of the accounting reforms, H.W.S. Whiffin, the Assistant Accountant General, served as a civilian paymaster on active service in the Crimean theatre of operations.

In this respect, accounting reforms of the Ordnance Factories tended to originate internally. There appeared to be no external pressure for these reforms, which is why the accounting reforms of the War Office at a macro-accounting level were different from the more superior micro-accounting reforms of the Ordnance Factories. There is a tendency to assume that the Ordnance Factory reforms occurred in the way that they did in order to relate to the best practices in the contemporary private sector generally. However, on further reflection this proved not to be the case. Indeed, the accounting reforms of the Ordnance Factories from 1862 tended to be superior to the prevailing business culture in the Victorian liberal economy.

Prior to 1862 the state of the accounting function at the Ordnance Factories could not show any comparison between the cost of production and the equivalent cost under contract. There was no double-entry book-keeping. According to one of the architects of the reforms, J.C. Hurst, there was no system at all.

The purpose of this chapter is to examine these reforms as they were manifest from 1862 onwards. There is also a clear lineage from 1862 through to the cost

accounting experiment in the British Army from 1917 to 1925. These nineteenth-century reforms were a microcosm of the recent reforms introduced in 1995 by the then Conservative Government under the 'Better Use of Taxpayer's Money' concept (Cm 2929, 1995) and the introduction of RAB into government departments.

Again, the earlier nineteenth-century reforms of the Ordnance Factories put in place an accounting system which seemed to have been forgotten between 1915 and 1919 when the Ordnance Factories came under the control of the Ministry of Munitions. In fact the official, though unpublished *History of the Ministry of Munitions* fails to acknowledge these earlier reforms and, on their reintroduction in 1917, claimed that these were being used for the first time by the government in the Ministry of Munitions.

Equally, it must also be remembered that the experiences of cost and financial management procedures of the First World War, particularly as manifest in the Ministry of Munitions, were short-lived in the post-1918 period. For example, the cost accounting experiment in the British Army was terminated after six years. Cost accounting in the private sector in Britain did not really come to fruition until the Second World War; nor did it become a permanent feature of British industrial life until well after the post-war period. This theme is further explored in Chapter 8.

The major reforms in the United States during the 1920s and 1930s made little influence in the private sector of Britain during the inter-war period. Although Marriner suggests that there was no universal standardized system of accounting within the various government departments, certain reforms did emerge in the Ordnance Factories, which Marriner only touches on in her paper on Government Accounting and the First World War (1994: 452).

In assessing the development of professional management in the public sector in the UK from 1855, the overall aim of this chapter is to underpin the argument that the management reforms in the Ordnance Factories produced efficiencies which were probably superior to those in the contemporary private sector. The development of costing and financial management in the Ordnance Factories from the mid-nineteenth century also influenced other reforms including scientific management, labour flexibility and of pieceworking. Overall, these reforms were far more advanced than in the contemporary private sector.

In order to appreciate these management reforms more fully, the evidence given to two Parliamentary Select Committees on Ordnance (both chaired by William Monsell) of 1862 and 1863 and the later Morley Report of 1887 (C 5116) is particularly relevant to this thesis. Indeed, the later Morley Report into the workings of the government manufacturing departments actually clarifies more fully the two earlier Monsell Committee reports of 1862 and 1863. In particular the evidence of the chief accountant and auditor of Ordnance Factory accounts, James Charles Hurst, is crucial. Like other reformers in the development of professional management in the Ordnance Factories, Hurst was a civil servant rather than a soldier-technologist. Hurst was very influential in the quality of evidence given to all three reports. As a junior civil servant, Hurst conducted most of the background research and reforms which formed the basis of Whiffin's evidence given to the two Monsell committees in 1862 and 1863.

There is evidence to suggest that DEB existed in certain government departments prior to the Northcote Trevelyan reforms of the civil service. Despite this, even by the mid twentieth century the findings of the Crick Report of 1950 (Cmnd 7976)

were still averse to the introduction of any commercial principles in government accounting, including DEB.

The relationship between costing and DEB

The initial management reforms at the Ordnance Factories involved accounting and DEB. These reforms themselves may already have been practised in the Naval dockyards. As a major area of this thesis will be involved in assessing the accounting reforms within the Ordnance Factories, it is worth at this point defining the relationship between costing and DEB.

Edwards (1994: 272) argues that interest in costing developed during the last quarter of the nineteenth century as profit margins declined. Therefore, industry became more competitive and capital-intensive and overheads were perceived to be more important to entrepreneurs than had otherwise been the case, but the development appears to have been led by engineers rather than accountants (Parker, 1986: 41; Loft, 1994: 118).

Financial managers could only carry out the management of the enterprises under their control effectively if they have full information of all the factors relevant to their area of control. Important factors included:

- i) market potential, consumer requirement;
- ii) competitive position - prices, quality and plans of competitors;
- iii) economic environment - trends, credit availability;
- iv) personnel - skills, morale, objectives;
- v) production - processes, capacity, quality levels;
- vi) engineering - plant life, power requirements, enhancement of new technology;

- vii) purchasing - material prices, quality, reliability of suppliers;
- viii) costs.

Costing is the information that indicates the economic implications and consequences of management decisions. The values of resources used are found and the techniques employed are all aimed at arranging money information in such a way that management is given as clear an indication as possible of their performance and the direction in which they must move in order to improve their economic efficiency.

Cost can be defined as the value of the economic resources used. As part of the development of a form of cost control it will be appropriate to establish 'cost centres'. These are parts of a financial enterprise to which costs may be charged, e.g.

- a) geographical - department or sales area;
- b) an item of equipment - lathes, delivery vehicles;
- c) a person - salesperson, production worker.

Double entry book-keeping is a form of record keeping which is applied to financial transactions. As its name suggests, it is based on the principle that each financial transaction has a two-pronged effect on the business, e.g. cash spent may indicate the reduction of total cash held and the acquisition of an item of equipment. This technique is used to enable the entrepreneur or business manager to be provided with the information which will afford, at any chosen moment:

- i) the production of a trial balance, which will prove the arithmetical accuracy of the recorded work;
- ii) each entry is so recorded as to give the business a complete history of all that has taken place;
- iii) the detailing of amounts owing to and owed by the business;

- iv) whether the business is trading at a profit or a loss and details as to how the result arose;
- v) the constituent assets and liabilities which the business has created - is the business succeeding or failing.

The system of DEB represents a comprehensive orderly and methodological approach to the maintenance of a financial structure.

It is argued that by 1914 the financial and cost accounting within the ordnance factories was completely integrated. For some reason this was not recognised, or continued from 1915 when the ordnance factories were transferred to the Ministry of Munitions. However, the origins of the short-lived cost accounting experiment in the Army from 1917 to 1925 came from the pre-1914 ordnance factory reforms, rather than from the wartime Ministry of Munitions.

Cost accounting emphasises the control and decision making of an organisation more so than the stewardship of the book-keeping function, though both are inter-related. The basis of any cost accounting system is only as good as a basic DEB system. Moreover, cost accounting is that part of accounting definition which is concerned with the internal reporting function to the management or decision-making element of the organisation or enterprise (Parker, 1984: 115). Parker also suggests that cost accounting:

"... in its original meaning [involves] the accumulation and assignments of historical costs to units of production and departments primarily for the purpose of stock valuation and profit measurement." (Parker, 1984: 47)

The terms 'cost accounting', 'cost management' and indeed 'costing' often tend to be used interchangeably. These terms represent the use by management of cost-based information (Fleischman and Tyson, 1993: 503).

In its twentieth century definition, cost accounting is difficult to distinguish from management accounting, however management accounting is the term developed during the post-1945 era to describe the provision "for management, of statistical information for the purpose of planning, decision making and control" (Edwards and Newell, 1991: 35).

Cost accounting must be distinguished from the practice of financial reporting. This particular discipline was developed in the sixteenth century as an aid to merchants (Garner, 1954: 1-26; Wilson, 1995: 29). Wilson suggests that it is important to recognise that because fixed investments were usually small in mercantile business, traditional financial accounting which in the main meant double-entry book-keeping, did not accommodate overheads when calculating the cost of a product (Wilson, 1995: 29; Chatfield, 1977: 99-101).

In terms of relationship between costing and DEB, the Acting Controller of Army Cost Accounts in 1918 Lt. Col. J. Grimwood defined this by classifying accounts into:

"... two great headings. The first heading is what one would call the ordinary commercial accounting or counting-house accounts... These accounts are purely the book-keeper's accounts and record transactions with outside people or departments, which are translated into money or money's worth.

The second heading is a system of accounts which can be best described as the departmentalisation of the counting-house accounts, and deals especially with recording the separate cost of the various processes in the production of an article. In other words, it deals with the departmental costs which go to make up the total cost of the finished product." (Grimwood, 1919: 114)

Grimwood made the crucial distinction between costing and DEB on the need for a system whereby a comparative analysis could be made. On its own, DEB cannot achieve this.

Ashworth (1953) gave an example from the 1930s of the use of costings as a decision-making tool used by the Director of Contracts, in deciding the best option to order artillery shells either from the Royal Ordnance Factories (ROF) or from trade. The example used by Ashworth, although from the 1930s, was as relevant in the pre-1920 Army Contracts Department: "Contracts with regular shellmakers were at fixed prices but in 1934-35, owing to the wide difference between trade and ROF prices, they were checked by costing, which showed that commercial prices were much higher than those of ROF" (Ashworth, 1953: 128). A similar scenario prevailed in 1862-63 over the trade price of the Armstrong gun made at Elswick compared to prices at the Royal Gun Factory and is described later in this chapter.

Evidence of double entry accounting in the pre-Northcote-Trevelyan Board of Admiralty and Board of Ordnance

There is evidence to show traces of change in the financial management and reporting within governments before 1850. The case of the Admiralty under Sir James Graham's naval reforms have already been stated. Certain government departments were using double entry accounting systems before 1830. This appeared to be confirmed in the evidence of the Public Accounts Committee which convened on 7 June 1837. The Committee's chairman, F.T. Baring, questioned J.T. Briggs (Accountant General of the Navy) who explained that double entry had been introduced into the Navy by a Mr. Thompson in about 1828. Briggs, in his deliberations to Baring, confirmed that "the whole of the accounts of the Navy Department were kept by double entry" (BPP, 1837, vii: 381). Other government departments using DEB included the Paymaster General's Department and the Colonial Office.

Corey, writing in 1840, argued that the Admiralty was advanced in the technique of double entry accounting due to its complex financial structures and links with contractors. The system of overall control contained the complexities of Admiralty business included:

"the system adopted in the Admiralty is the Italian method of double entry with the common mercantile ledger and journal and proper subsidiary books." (1840: 101)

Parker (1907: 166) quotes Lord Welby who, in 1856, became a clerk in the Treasury. Welby described Anderson as being head of the Finance Department at the Treasury in 1856, stating that:

"Sir William Anderson, when quite a young man outside the service had been picked up by Graham to aid him in devising the new scheme of accounts in the Admiralty ... and Anderson was transferred afterwards to institute accounts and reform financial procedure in other Departments. In fact, he is the author of our present system of account throughout the service... One of the first acts of Mr. Gladstone, on becoming Chancellor (December 1852) was to bring him to the Treasury and make him head of the Finance Department." (Parker, 1907: 166)

There is also evidence to suggest that the Ordnance Department, then under the remit of the Board of Ordnance, had developed a system of double entry accounting from 1840. A Treasury minute dated 3 December 1841 commented:

"... that the system of account by double entry has been in use in the Ordnance Department for upward of 10 years ... but however useful this improved method of keeping the accounts may be in the internal administration of this department, it cannot furnish that information, out of the department, which is indispensable to the exercise of a proper control over its proceedings, until the accounts are embodied in the abstracts of the nature of those which it is proposed should be annually prepared." (BPP, 1844, xxxii: 744)

Here, the Treasury have identified the sporadic use of double entry accounting at a micro level in certain departments.

Forms of accounts

Part of the problem when assessing the development of financial management through double entry accounting systems into public departments, is the elusiveness of the evidence. If Hurst did introduce double entry accounting systems into the government manufacturing departments in 1864, this does not adequately explain what happened since the introduction of double entry book-keeping into the Ordnance Department over twenty years earlier. It may well be that the double entry accounting system as introduced into the Ordnance Department did not extend to the subordinate government manufacturing departments. Such inconsistency and sporadic reforms of one department but not the other were common at the time.

The Morley Committee (C 5116, 1887), in assessing the workings and organisation of the government manufacturing departments in 1886, commented that the system of double entry accounting at the Ordnance Factories was operating very satisfactorily. This was confirmed by Hurst and by the superintendents and managers of each factory. There is no evidence to suggest that the double entry accounting system at the Ordnance Factories was terminated between 1887 and 1915. Thus when the Ministry of Munitions took over control of the Ordnance Factories in November 1915 it is likely that the double entry accounting system of the War Office controlled Ordnance Factories was also transferred to the new monolithic Ministry of Munitions. However this is not acknowledged in the official history of the Ministry of Munitions. Volume 3 of the history makes great play of the introduction of a double entry system introduced into the Ministry in March 1917 (*History of the Ministry of Munitions*, vol.3, ChIII, Part 1: 80). Although Harris, in evidence to the Committee on the Royal Ordnance Factories in January 1919, criticised the accounting systems of the Ordnance

Factories during the era of the Ministry of Munitions control, he suggested that the pre-1915 system was superior (MUN, 4/63751). This is explored later in this chapter and in more depth in Chapter 8.

The problem of interpretation is made complicated by the virtual semi-independence of each government department and indeed sub-departments within the pre-1914 civil service. This perhaps reflects the role culture model of the pre-1914 civil service (Handy, 1993: 185). Although the role culture model is often stereotyped as bureaucracy, it is the role concept that is more pronounced.

The civil service is often cited as an example of a role culture model. Indeed, the role organisation will only succeed when it operates in a stable environment. As with the War Office, during the nineteenth century until 1914, hostilities often disturbed the role foundation. Also, the attitude towards specialists of a role organisation may explain why there were sporadic reforms in financial management within public departments until 1925.

Any double entry accounting system could not be superimposed into the final departmental accounts as submitted to Parliament. Indeed, in its pursuit of uniformity the Treasury strove to maintain the cash-related accounting system for Parliamentary accounts. In the deliberations around the fourth report of the Committee of Inquiry into the system of account and audit in the Ordnance Department, the Treasury, in a written opinion of 7 March 1844, declared that:

"The accounts of the annual income of the kingdom are founded on the actual receipts in the year; the account of the actual expenditure for the public debt is an account of actual payments in the year... The mode of accounting for the whole should, in our opinion, be uniform."

The committee itself emphasised that:

"It is in accordance with the principle adopted by the Committee of the

House of Commons in 1822 to consider the best mode of simplifying the accounts annually laid before Parliament. The balance sheet recommended by that Committee, and which has been ever since annually laid before Parliament, is simply a classified account current of the actual receipt and expenditure into and from the Exchequer within a definite period of time." (BPP, 1844, xxxii: 745)

Thus the cash-based system of accounting culture prevailed well into the late twentieth century. The changes at a micro level, particularly within the government manufacturing departments from 1862, did expose contract suppliers, particularly in relation to the Armstrong gun, but parliamentary accounting made no provision for accrual accounting. A transaction was only recorded in parliamentary accounts when a cash exchange took place. Indeed, the recommendations of the 1950 Crick Committee on the form of government accounts (1950, Cmnd 7976) tended to be adverse to both accrual accounting and cost accounting, as well as DEB, a point made earlier. Apparently the Crick Committee was influenced in its decision by the apparent failure of the cost accounting experiment in the British Army some twenty-five years previously (Wright, 1956: 463).

Crick recommended that "the main Exchequer Accounts and the framework of both Estimates and Appropriation Accounts should be on a cash basis" (Point 1 in summary, p.57) and "the subjective basis of the Estimates should be retained" (Point 19 in summary of main conclusions, p.58). Indeed, Crick had recommended the continuance of a cash-based charge and discharge system of Exchequer Accounts that had existed from the nineteenth century, apart from the six years of the Army's cost accounting experiment (Cmnd 7969, 1950, Appendix C, p.69).

**The link between the earlier reforms of the Navy and the Ordnance Factories:
the Whiffin family and James Charles Hurst**

The earlier Graham reforms of the Navy between 1832 and 1837, which included the establishment of the Accountant General's Department of the Navy, also introduced DEB into Admiralty accounting.

By 1862 DEB was not a system used in the Ordnance Factories and this was established by the Assistant Accountant General to the Army H.W.S. Whiffin. However, Whiffin admitted that DEB was used in the Admiralty dockyards and supply departments. In evidence to the 1862 Monsell Committee, Whiffin responded negatively when asked whether the accounts at the Royal Gun Factory were kept by double-entry. Whiffin did not know why the accounts were not kept by double-entry and suggested that they did not employ a professional accountant there. The examiner, Sir Frederick Smith, a member of the Monsell Committee, stated that:

"In the Admiralty and in the dockyards are not the accounts all kept by double-entry?"

Whiffin replied:

"An establishment has recently been formed in the Admiralty for that purpose; a very large addition to the establishment was made, but the accounts of our manufacturing departments have been rendered to the public without any additional cost, but if a system of book-keeping by double-entry were adopted at the gun factories, it would lead to a very considerable expense and I do not think that it would lead to any improved results in the accounts."

When pressed by Sir Frederick Smith whether the manufacturing departments of the Navy and the War Office should be structured on the same system, Whiffin suggested that whilst he could form no opinion "upon the subject of Navy accounts, ... I am satisfied that the accounts rendered by the Woolwich Departments answer to the purpose in every respect" (Monsell, 1862; evidence given by H.W.S. Whiffin,

questions 128-130, pp.6-7). At the time of giving this evidence Whiffin was exploring the possibilities of introducing DEB into the Royal Gun Factory.

The name Whiffin was contemporarily synonymous within the Royal Navy, the Accountant General's Departments of both the Navy and Army. Here, it is argued, is the crux of the accounting reforms of the Ordnance Factories.

Henry William Sharp Whiffin (1824-1904) was born at Deptford (the home of the Naval dockyard, victualling yard and naval ordnance factories). His father was a wheelwright. At the age of 14, H.W.S. Whiffin became a clerk in the original Board of Ordnance. During the Crimean War he served as a civilian paymaster to the Ordnance Department, serving in the field at Gallipoli, Scutari, Varna and in the Crimea itself. H.W.S. Whiffin received the Crimean War Medal with three clasps (Alma, Inkerman and Sevastopol) and the Turkish Crimea War Medal. For the period 1857-58 Whiffin was specifically employed by the Indian Government to "report upon the accounts and bring up the Indian store accounts" (War Office Staff List, 1872: 248). In 1863 Whiffin reported to the Monsell Committee that "an application has been made by the Indian Government for a short period in connexion with Public Works in India" (Monsell, 1863; evidence given by H.W.S. Whiffin, p.278). The War Office Staff List qualified Whiffin's modest statement by stating that he "proceeded to India under a Special Commission to inquire into the Public Accounts" (War Office Staff List, 1872: 248).

In 1860 Whiffin had been appointed as one of two Assistant Accountants General at the War Office. His remit was overall responsibility for the financial management of the Ordnance Factories. In February 1865 Whiffin also became Chief Auditor of Army Accounts and a Commissioner of Income Duty in April 1866.

Finally, in April 1870, H.W.S. Whiffin was appointed Accountant General to the Army. The following year, however, Whiffin resigned on a pension of £650 a year. He became a chartered accountant and practised in the firm of Lovelock, Whiffin and Co., Coleman Street, London.

H.W.S. Whiffin's two younger brothers, John George Whiffin (1826-1892) and Alfred Whiffin (1837-1910) both became Paymasters-in-Chief of the Royal Navy respectively. J.G. Whiffin entered the Royal Navy as a clerk in 1843 when he was 17 years old. He was employed in the surveying ship HMS Tartarus when she was deployed in the River Shannon on anti-riot duties (the O'Connell riots). J.G. Whiffin was appointed as clerk on HMS Herald, serving in this ship for over six years, in which time he made three voyages in the Arctic through the Baring Strait in search of the previous Franklin expedition. Whiffin received the Polar Medal. In 1851 J.G. Whiffin was appointed as Assistant Paymaster, then Paymaster in 1851. He was on active service during the Crimean War, serving in the Baltic and at the Siege of Sevastopol in HMS Gladiator. Whiffin received the Baltic Medal and Crimean Medal with clasp Sevastopol. J.G. Whiffin was appointed Paymaster-in-Chief in 1873 and retired from the Royal Navy the same year at the age of 47 years, on retired pay of £305 per annum (*The Times* obituary notice, 11 January 1892; Navy record PRO ADM 19611). The relationship between the three brothers was substantiated through baptismal records for the Parish of St. Pauls, Deptford - entry no.1125 for H.W.S. Whiffin's date of baptism on 5th January 1825 and for J.G. Whiffin no.1924, date of baptism 11th September 1826.

A second naval connection contemporaneous with the Whiffin brothers was their uncle, John Whiffin (1804-1871), a civil servant in the Accountant General's

Department of the Navy. The 1851 Navy List records, under the Civil Section, Department of the Accountant General, John Whiffin, clerk of the second class employed in the Invoice and Claims Branch. Ten years later, in 1861, the Navy List under the Department of Accountant General records John Whiffin Esq. as Chief Clerk (Cash and Accounts Section). By 1868 John Whiffin was Assistant Accountant General for Pay in the Accountant General's Department for the Navy (Comptroller of Seamen's Pay).

John Whiffin retired to Tunbridge Wells in 1869 and died there two years later. He may have been the influencing factor behind the public careers of the Whiffin brothers in Army and Naval administration.

The major architect of financial and accounting reform within the post-1855 Ordnance Factories was James Charles Hurst. From the 1881 census, Hurst was described as having been born at Wareham, Dorset. He was a career civil servant who joined the newly reconstituted War Office as a temporary clerk in 1855. He was then about 25 years old but nothing is known about Hurst's career prior to 1855.

However, his marriage certificate of 18th June 1859 describes his occupation as a clerk in the War Office and his father's occupation (Limpus Hurst) is described as a clerk in the Audit Office.

The War Office Staff List for 1864 describes Hurst as an Accountant Third Class in Subsection E of the Accountant General's Department. This particular subsection was responsible for the compilation, preparation, audit and presentation of the Ordnance Factory accounts to Parliament. By 1881, the official census records Hurst as "an Accountant at the War Office". At this time Hurst was residing at Broxbourne, Herts. This was close to both the Royal Gunpowder Factory at Waltham

Abbey and to the Enfield Rifle Factory (Enumerator's List for Broxbourne, Herts., 1881 Census, PRO/11/1399).

Hurst's evidence to the Morley Committee of 1886 gives an in-depth appreciation of the financial reforms of the Ordnance Factories from 1862 to 1864. Also Hurst describes the prevailing system which existed prior to 1862, which he described as non-existent. Hurst's evidence to the Morley Committee clarifies the earlier Monsell Select Committee reports some twenty-five years prior to Morley.

The first Monsell Committee was "intimately connected" with both the Armstrong and Whitworth principles of artillery manufacture. Hurst remembers the witnesses from both companies appearing before Monsell.

In his evidence to Morley, Hurst recounts the prevailing system of accounting at the Royal Arsenal before 1862. All the various items of expenditure in the records of the (Woolwich) Department were adopted as debits. Credits *per contra* for the approximate cost of production were calculated during the year. Whatever the difference shown between the estimated cost and actual cost, was adjusted by a percentage being added or deducted from the approximate cost of production all round to make both sides of the account equal in amount. Hurst further explained as follows:

"Supposing that the total charges, we will say, on the debit side of their balance sheet amounted to £500,000; and then supposing on the other side by the estimate which they had prepared of their total production, it had turned out that the estimated cost was £600,000, without knowing what their debit was going to be, they first of all considered that the estimate of £600,000 would correctly represent what they produced at cost price; but as they could only charge themselves with £500,000, they could not take credit for the £600,000, for the simple reason that £100,000 of the credit side would represent an over-estimate of the cost; and, therefore, to reduce that £600,000 to £500,000 they took off every item of manufacture the percentage that would make both sides fit."

The Chairman, William Woodall MP, enquired of Hurst: "Was there any attempt at that time to assess the value of the plant and the capital employed?" Hurst replied that there had been an attempt but that it was never taken into consideration "in any shape or form in their cost" (C 5116, 1887: question 3378, p.192).

Woodall pressed his question further, enquiring whether the accounts kept at the time at the Arsenal enabled a comparison between the cost of production and the cost at which "similar things could be purchased by contract". Hurst recollected that an account was kept which, although it was accepted as useful to the purposes at the time, was considered by Hurst as being no system at all. This opinion was presented to the Monsell Committee in 1862.

Mr. Ruston, a member of the Morley Committee (question 3381) enquired when this system happened. Hurst replied that improvements occurred in 1864 when he received a final decision. He recalled that "Lord de Grey was in power at the time, Lord Ripon as he became afterwards". Hurst pointed out to Monsell at the time that the only way to get a satisfactory system was to introduce pure and simple double entry (C 5116, 1887: 192-3).

In clarifying a point from the Chairman, Hurst confirmed that in 1860 there was no double-entry system at all at the Arsenal or at other government manufacturing departments. Lord de Grey, at the recommendation submitted by Hurst, through the Accountant-General instigated the double-entry system. Lord de Grey had granted Hurst permission to visit a large number of manufacturing establishments, particularly in the north. This was perhaps five or six years after the Molesworth Committee sent a delegation to the northern manufactories. The results of Hurst's visit are not known as the internal reports and other papers apparently no longer exist.

The name of Hurst is a common feature in this thesis. By 1887, at the time of the Morley Inquiry, Hurst was the War Office Chief Accountant and Auditor of the Ordnance Factories.

The role of H.W.S. Whiffin and J.C. Hurst is apparent within the reforms of the Ordnance Factories during the latter part of the nineteenth century. However, the link between the Whiffin family and Hurst is also associated with General Sir George Chesney - the reformer of the Indian PWD - and the Royal Indian Engineering College, Cooper's Hill, Surrey. J.G. Whiffin retired as Paymaster-in-Chief, Royal Navy and in 1878 he was appointed Secretary to Cooper's Hill College, a post he held until his death in 1891. Hurst was appointed at the first lecturer in accounts at the College in 1879, a post he held in conjunction with his War Office post as Chief Accountant and Auditor of the Ordnance Factory accounts (see chapter 2).

It is possible that Hurst also knew J.G. Whiffin well and that H.W.S. Whiffin may have had some influence in suggesting that Hurst was the person who would be the most suitable choice. Again, the Accounts syllabus at Cooper's Hill College may have been drafted by Hurst, J.G. and H.W.S. Whiffin, who was by now a chartered accountant. Hurst continued to lecture at Cooper's Hill College until 1900 and marked accounting papers until 1904, three years prior to his death. As previously stated in chapter 2, accounts as a subject was withdrawn from the syllabus in 1904 due in part to there being found no suitable candidate to teach accounts. There is evidence to suggest that the Royal Indian Engineering College, Cooper's Hill may have been the first institution to train managers for the public sector, mainly for the Indian PWD, though graduates of Cooper's Hill also entered the Colonial Service and served from Africa to the Far East. The Whiffin brothers, and their uncle John Whiffin, as welll

knowledge of costings and accounting procedures. Concepts such as accrual accounting and depreciation were rarely practised with any amount of consistency in the private sector until well into the twentieth century. This point is explored more fully later in this thesis.

Evidence of costings and depreciation with the development of the Armstrong gun at the Royal Gun factories and at the Elswick Ordnance Company

The excess in expenditure during the building of the extension at the Royal Arsenal Woolwich came about just after the Crimean War. During the Crimean War, particularly at the Battle of Inkerman on 5th November 1855, the heavy guns of the Royal Artillery avoided a British defeat, despite the difficulties in positioning the guns, the rate of fire and reloading time, and the immense manpower required to make the guns fire efficiently. Armstrong had developed relationships with the Board of Ordnance in 1854 when he designed submarine mines to protect the harbour facilities at Balaclava and Sevastopol, though the outcome of this project came to nothing (Warren, 1989: 12).

However, Armstrong began to design a lighter, more efficient gun with a rifled barrel. Warren (1989: 12) suggests that Armstrong became preoccupied with developing such a weapon more as a leisure activity than for any other reason. Two British inventors began to develop rifled ordnance in the aftermath of the Crimean War, Sir Joseph Whitworth, and Sir William Armstrong. Also the French and Germans were conducting research and development in rifled breach loading ordnance and their research was at a more advanced stage. In terms of testing patents and inventions, the War Office during the mid nineteenth century had quite flexible plans for the

testing and costing of these. The system had become more flexible since the demise in 1855 of the office of Master General of Ordnance and the Board of Ordnance. (For a comparison in the ballistics performance and costing of the Whitworth gun compared to the Armstrong gun, see Warren, 1989: 12-13; Wilcox, 1999: 57-61.)

The development of the Armstrong gun was achieved at a crucial point in the immediate post-Crimean War period. The Indian Mutiny was far from resolved, a new Indian Army with British Army elements had to be re-equipped, and in foreign policy Anglo-French relationships were deteriorating whilst at the same time both countries were rearming.

As previously stated, Armstrong refused the financial reward offered by the government, and gave his patent to the War Office. In return Armstrong who was a director of the Elswick Company, accepted the post of superintendent to the new Royal Gun Factory and, whilst remaining a director of Elswick, also refused any financial remuneration for his directorship there.

However the government placed orders for the new Armstrong artillery piece with the Royal Gun Factory and under contract with the now restyled Elswick Ordnance Company. But the Elswick Company (as did the Ordnance Factories) could only sell its output to the War Office. In return, the War Office gave machinery to the Elswick Ordnance Company as well as up front payments to assist the development of their Armstrong production line.

The development of the Armstrong gun at Woolwich, transformed the original Royal Brass Foundries into a much larger Gun Factory. The impetus of the Armstrong gun revolutionised the original craft workshop system of manufacturing brass smooth bore cannon at the Brass Foundry, into a major factory system.

as J.C. Hurst must therefore be seen as pioneers in this development.

The introduction of capital accounts into the Ordnance Factories

Capital Accounts for the government manufacturing departments were introduced in 1862. The origins of the Capital Accounts and of depreciation within the government factories occurred a few years earlier between 1855 and 1857, when after;

"Referring to the several letters from the Heads of Departments at Woolwich ... stating the large excesses which have been discovered upon the grants for various works which have been executed in the Arsenal" (WO 33/4 A and B, Report of the Committee into the Excess of Expenditure in Woolwich Arsenal)

Lord Panmure, Secretary of State for War, instituted "a searching inquiry into the causes which led to these excesses, and the best mode of preventing them in future" (WO 33/4 A and B).

The Report recognised that part of the problem was caused by the heavy demands being made at the time to re-equip and replenish munitions for the British Army in the field. As Chesney had pointed out concerning junior military engineer officers in India, the keeping of accurate accounts formed a most crucial part of his duty. In fact this could actually cause a conflict of interest between maintaining the accounts, and conducting and managing the project at hand (*The Calcutta Review*, vol 64, 1859: 359, see also Chapter 2).

The crisis over the excess of expenditure at Woolwich Arsenal may have resulted in a change of accounting procedures which were highlighted a few years later with the development and manufacture of the Armstrong gun both at Woolwich and under contract from the Elswick Ordnance Company. Suffice to say at this point that along with civilian engineers, there is evidence that military engineers had a practical

The Armstrong gun was initially made of wrought iron, through coils being forged together into a barrel. Later production from 1862 was through interchangeability, due to modifications made by Fraser (see Chapter 3). The payment system was transferred from day payment to one of piece-work. Production of the Armstrong gun commenced in 1858, the same year as interchangeability began at the transformed Royal Small Arms Factory, Woolwich.¹

The earlier Armstrong guns were muzzle loading. Though Armstrong attempted to develop a fail-safe breech loading artillery piece, he was not altogether successful in this venture. However, there is some disagreement concerning the success, or otherwise of Armstrong and the development of breech-loading ordnance. Scott, in his history of Vickers (1962) argues that it was the conservative attitude of both the Admiralty and the War Office which scuppered Armstrong's plan for breech-loading artillery (1962: 30). However, this contradicts Armstrong's own testimony. For example, in 1881 when Armstrong was elected as President to the Institution of Civil Engineers, he made reference to muzzle-loading artillery, in his inaugural address, and favoured this method, particularly for shore defences where, "muzzle-loading guns can be mounted in such a manner so as to be loaded under the shelter of an earthen parapet, by hand worked machinery of the very simplest description" (Armstrong's Inaugural Address, Proceedings of the Institution Of Civil Engineers, vol.68: 37, 1881-82).

Scott assumed that the War Office wanted an excuse to terminate the Elswick contract, and used the argument for muzzle-loading ordnance as a preference to

¹ For a detailed description of the production process and coiling in the manufacture of the Armstrong gun, see notes made by Captain Francis S. Storey, Assistant Superintendent Royal Gun Factories 1870-71, quoted by Hogg, 1963: 904; see also Wilcox, 1999: 57-61 and Warren, 1989: 12-13.

breach-loading (1962: 30). This is not a correct analysis of the situation, as will be shown shortly. Scott suggests that "According to an official enquiry after the event it was reckoned that half a million pounds had been spent at Elswick and that half this sum might have been saved if the government had drawn all its material from the Royal Ordnance Factory" (1962: 30).

In his history of Armstrong's of Elswick, Warren only briefly refers to the War Office contract with Elswick to produce Armstrong guns. Warren states that:

"The circumstances of the case were complicated as is shown especially in the conflicting statements about the money spent at Elswick in the period of the contract... An assistant Accountant General at the War Office reckoned that if goods purchased from Elswick over a three-year period at a cost of £593,000 had been bought from Woolwich, £242,000 might have been saved. The evidence for his statement was, however, disputed." (Warren, 1989: 16)

The Assistant Accountant General in question was H.W.S. Whiffin, as previously mentioned, but Whiffin's assessment may have been more accurate as the accounts produced by the Royal Gun Factory and compiled by Whiffin were more advanced than those produced by Elswick.

The two Parliamentary Select Committees on Ordnance (Monsell, 1862: 63) investigated this episode. The results of both Committees found that case proved that the Elswick guns were of inferior quality and cost more to produce than the corresponding Woolwich guns, as well as accepting the Armstrong gun in preference to the Whitworth gun. It was Robert Fraser who modified the production process of the Armstrong gun into a successful breach loader, though the heavier guns remained as muzzle loaders.

The first Monsell Inquiry of 1862 reflected a change in procedures in the format of Parliamentary accounts submitted to Parliament. The changes were made

due in part to the Elswick contract, and also due to the previous excess in expenditure at Woolwich Arsenal, as already described. The 1862 Monsell Committee on Ordnance in particular investigated the manufacture and supply of the multi-calibred Armstrong gun both at the Gun Factory, Woolwich and those manufactured under contract from the Elswick Ordnance Company.

However, there is evidence to suggest that the method of accounting at the government manufacturing departments was being altered just prior to the Monsell Committee convening in 1862. The Assistant Accountant-General, H.W.S. Whiffin had begun a costings exercise at the Royal Gun Factory in January 1862, three months before the Monsell Committee began its deliberations. He had sent his subordinate, J.C. Hurst, together with J. Anderson, the deputy superintendent of the Royal Gun Factory, to assess and analyse the costing surrounding the manufacture of the Armstrong Gun.

Whiffin acknowledged to the Accountant General the zealous work of Hurst. Whiffin's memorandum was appended to the 1862 Monsell Report.

"The manner in which Mr. Hurst has conducted the inquiry fully confirms the opinion that I have already expressed in regard to his capabilities as an accountant, and of his qualities as auditor of our manufacturing accounts." (Monsell, 1862, Appendix 182, copy of memorandum dated 10 June 1862; manuscript of the original memorandum, SUPP 5/297/34931)

Also, Whiffin, in direct evidence to the 1862 Monsell Committee, related how:

"Mr. Hurst, the accountant who had gone into the detail of those accounts at Woolwich and had eliminated from the general charges in the Royal Gun Factory and all those general charges which he considered belonged to the other work than guns which is produced at Woolwich ..." (Monsell, 1862: 119, question 2389)

The balance sheet as drawn up by Whiffin and Hurst was secondary to a first balance sheet already in existence which was designed for public knowledge being the balance

sheet presented to Parliament. The second balance sheet (the Number 2 balance sheet) was intended for internal Parliamentary scrutiny only and omission from the public may have been due to reasons of commercial confidentiality. The Number 2 balance sheet showed overheads including depreciation of buildings and machinery. The indirect overheads were charged pro rata to labour and materials. It would appear that this second balance sheet was a document which would be useful in any costings exercise.

The indirect expenditure data was obtained from the cost and principal ledgers and represented those charges which could not be debited against any particular order. Such charges included salaries, superannuations of civilian staff of managerial, administrative class grade of the civil service, repairs to machinery, engine power, sweeping of roadways, rates and divine service.

Within each government manufacturing department was an Estimates Branch, which was immediately subordinate to the factory manager. It was staffed by a class of clerks called mechanical writers, mainly recruited from selected industrial class of workers (this is further examined in Chapter 6).

The Estimates Branch was staffed by:

- One senior mechanical writer, who worked alongside the factory manager, and
- seven mechanical writers.

The role of the Estimates Branch was as follows:

- Preparation of all estimates of cost.
- Preparation and revision of all piecework prices.
- Investigations of queries arising in the works accounts branch.
- Maintain records of weights and tonnage of articles manufactured.

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It would not be advisable in the first instance to define the duties of the gentlemen intrusted with this charge, as so much depends upon the intelligence of the officer to be selected and the cordial co-operation of the heads of the various departments; but I apprehend that no difficulty would arise, as the several superintendents have always evinced very great disposition to assist this office to carry on any investigations which are considered by the Secretary of State to be necessary for the public service.

If this proposition be approved, I would, as stated on other papers, place at your disposal Mr. Hurst, who is at present employed in my section of your department. This gentleman is a thorough accountant; he is exceedingly intelligent, zealous, and painstaking; one in whom I should place every confidence, and who would, I am sure, perform the duty with great advantage to the public and credit to himself.

I would suggest that the balance-sheets to the 31st March last be at once prepared on the form suggested, and that the audit should commence forthwith. It is desirable that no time should be lost, as the accounts should, if possible, be laid before Parliament during the present Session. This is the more desirable, as, on the presentation of a duly certified balance-sheet, the doubt which now exists as to the cost of our manufactures would be at once removed.

With a view, therefore, of bringing the whole subject to a speedy issue, I would suggest that a committee, composed of the heads of the several departments, should assemble in this office, and that this report be referred to them for any observations they may wish to offer; and should the committee require any further information, I shall be quite prepared to give it.

(signed) *H. W. S. Whiffin,*
Assistant Accountant General.

15 May 1862.

App. No. 4.

No defined instructions to be given to the Auditor at present.

Mr. Hurst's qualifications for the duty of Auditor.

Balance Sheets to 31st March 1862 to be prepared and audited at once.

Committee of Heads of Departments to report on this Memorandum.

(70—General No.—1347.)

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Dr.		BALANCE SHEET of the				Cr.									
		£.		s.		d.				£.		s.		d.	
								Detailed Statement.							
To value of buildings on the 1st April 1860		100,000						E.		By value of buildings on the 1st April 1860		100,000			
To value of lands on the 1st April 1860		100,000								Deduct, Depreciation during the year 1860, at 5 per cent.		5,000			
To value of machinery on the 1st April 1860		150,000				350,000		E.		By value of lands on the 1st April 1860				90,000	
To buildings and machinery added during the year 1860		50,000						E.		By value of machinery on the 1st April 1860		150,000			
To repairs to buildings and machinery during the year		5,000				35,000				Deduct, Depreciation during the year 1860, at 10 per cent.		15,000			
To value of stores &c., in stock on the 1st April 1860		60,000						L.		By value of buildings added during the year 1860		50,000			
To value of semi-manufactured articles on the 1st April 1860		15,000						L.		By value of machinery added during the year 1860		30,000			
To stores received from various sources during the year 1860		20,000								TOTAL Value of Buildings, Lands, Machinery, &c., on 31st March 1861				200,000	
To cost of stores acquired by purchase during the year 1860		150,000				265,000		A.		By value of stores in stock on the 31st March 1860		60,000			
To cash expended for salaries during the year 1860		100,000						G.		By value of semi-manufactured articles in stock, on the 31st March 1860		100,000			
To cash expended for wages during the year 1860		150,000						H.		By value of stores issued to other departments during the year		10,000			
To cash expended for sundry services during the year 1860		20,000				270,000		I.		By value of work performed for other departments during the year		5,000			
To miscellaneous charges						5,000		J.		By cost of articles manufactured, and of other work performed during the year 1860, the value of which, calculated at contract rates, where practicable, is estimated to be 620,000 <i>l.</i> ; thus showing a net saving upon Government manufactures of 174,425 <i>l.</i>				15,000	
Interest, at 5½ per cent. on capital invested in buildings, land, machinery, stores, &c., on the 1st April 1860						15,575				(See also Profit and Loss Account.)					
		£.		960,575								£.		960,575	

PROFIT and LOSS ACCOUNT of the ROYAL

Dr.

Cr.

Detailed Statement.		£.	s.	d.	£.	s.	d.	Detailed Statement.		£.	s.	d.	£.	s.	d.
A.	To value of stores, &c., taken over from the year 186	60,000	-	-				A.	By value of stores, &c., in stock, on the 31st March 186	60,000	-	-			
A.	To value of semi-manufactured articles, taken over from the year 186	15,000	-	-				G.	By value of semi-manufactured articles on the 31st March 186	100,000	-	-			160,000
B.	To value of stores, &c., acquired during the year 186	170,000	-	-	245,000	-	-	H.	By value of stores, &c., issued to other departments during 186	10,000	-	-			
C.	To cash expended for salaries during the year 186	100,000	-	-				I.	By value of work performed for other departments during 186	5,000	-	-			15,000
C.	To cash expended for wages during the year 186	150,000	-	-				J.	By estimated value at contract rates, of articles, &c., manufactured, and work performed, during the year 186				320,000	-	-
C.	To cash expended for sundry services during the year 186	20,000	-	-											
D.	To Miscellaneous charges during the year 186	-			5,000	-	-								
L.	To repairs to buildings and machinery during the year 186	-			5,000	-	-								
E.	To 5 per cent. depreciation on buildings for the year 186	5,000	-	-											
E.	To 10 per cent. depreciation on machinery for the year 186	15,000	-	-											
F.	To 3½ per cent. interest on capital invested on the 1st April 186	-			15,575	-	-								
	To balance, being the net estimated profit on articles, &c., manufactured, and work performed at the Royal during the year 186 (See also balance sheet)	-			114,485	-	-								
					£. 695,000	-	-						£. 695,000	-	-

(35,048—4.)

Assistant Accountant General, Mr. Whiffin, to the Accountant General.

(35,048—3.)

In compliance with the directions on another paper, I proceeded to Woolwich, accompanied by Mr. Hurst. I informed Mr. Anderson of what was required, when he at once placed the whole of his books at my disposal. I gave Mr. Hurst general directions as to the course the detailed examination should take, and he conferred with me on each day during his investigation; the result is clearly stated in the accompanying Report, in which I entirely agree, confirming, as it does, the result of my own general investigation of the books.

The manner in which Mr. Hurst has conducted the inquiry fully confirms the opinion that I have already expressed in regard to his capabilities as an accountant, and of his qualifications as auditor of our manufacturing accounts.

(signed) H. W. S. Whiffin.

10 June 1862.

(35,048—4.)

Assistant Accountant General (Mr. Whiffin),

In accordance with your instructions, my investigations at the Royal Gun Factory were directed, in the first instance, towards ascertaining, from reliable data, the precise cost of manufacturing guns upon Sir William Armstrong's principle, during the year 1861-62;

STATEMENT showing the COST in detail of ARMSTRONG GUNS manufactured at the ROYAL GUN FACTORIES during the Years 1860-61 and 1861-62; with the Rate per Cent. of General Expenses upon the Cost of productive Labour.

DESCRIPTION.	Cost of Labour for Gun.	Cost of Materials for Gun.	Proportion of General Expenses for Gun.	Actual Cost for Gun.	Interest on Capital for Gun.	Total Cost for Gun as per Balance Sheet when rendered.	Elswick Prices.	
1860-61 :	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£.	
6-pounders - -	43 17 6	16 17 4	21 9 5	82 4 4	5 2 7	87 0 11	256 4	For one experimental gun with recoil frame.
12 " - - -	35 17 2	27 4 2	17 10 11	80 12 3	5 - 7	85 12 10	170 4 Original price, 364 4.	
20 " - - -	70 17 3	64 17 4	34 13 7	170 8 3	10 42 7	181 - 10		
1861-62 :								
6-pounder - -	29 3 6	25 3 10	11 13 5	00 - 10	4 2 5	70 3 3		
12 " - - -	31 5 4	31 11 -	12 10 2	75 6 6	4 13 11	80 - 5	170 4 Original price, 364 4.	
20 " - - -	39 9 8	84 16 4	15 15 10	110 1 10	6 17 4	116 19 2		
1860-61 and 1861-62 :								
100-pounders	102 9 10	215 11 -	45 4 2	363 5 -	22 13 1	385 18 1	650 4 Original price, 700 4.	

(70.—General No.—1347.)

Accountant General,

UNDER your directions, I have recently inspected the cash and store accounts of the Manufacturing Departments at Woolwich; in doing so I had the following objects in view:—

1stly. To ascertain whether the present system of passing the weekly wages account on the certificates of the superintendents and other officers was fraught with any danger to the public.

2dly. To inform myself of the principle upon which the annual balance sheets are made up in the several departments.

3dly. To ascertain whether the books kept in the Manufacturing Departments afford reliable information as to the actual cost of the several articles manufactured.

1. The wages accounts of the three departments are, in their principal features, much the same, although the details differ; they are all, however, most carefully compiled, and subjected to checks and counter-checks, by which errors are scarcely possible. One main principle pervades them all, which is, that the cashiers are not in any way connected with the compilation of the check books, their duty being strictly limited to making the payments to the men after the amount of the wages has been declared by an independent officer.

Wages Accounts.

The facilities of payment are so great, the arrangements so perfect, and the checks so complete, that 2,900 men of the Carriage Department received the amounts due to them in the short space of 10 minutes.

Arrangements of Payment.

The weekly certificates, signed by the superintendents, chief clerk, and pay clerk, are, in my opinion, all that is required; and in regard to the payment of wages, and the wages books, the present system is complete in every respect.

Weekly Certificates sufficient.

2 and 3. In regard to the principle upon which the annual balance sheets are compiled, that established in the Laboratory and Gun Factories is, in my opinion, most satisfactory; that in the Carriage Department is, I think, susceptible of modification.

Principle upon which Annual Balance Sheets are compiled.

In the Laboratory, accounts are opened in the cost ledger for the most important articles manufactured, and general accounts for the smaller and more numerous articles. To these accounts, the actual cost of the materials used and wages expended in the conversion of the material is accurately posted; a further account is opened, to which is posted the whole of the general charges, *e.g.*, the pay of the staff, gas, water, and other expenses which cannot be definitely appropriated to any of the other heads of account; at the end of the year the balance of this account is divided *pro rata*, over the several accounts of articles manufactured.

Laboratory.

0.88;

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1n

- Preparation of lists of the component article of each service, for the guidance of the works accounts branch (C 5116, Morley, 1887, Appendix XVIII: 557).

In relation to costings reflecting tenders for contract to the private sector, the departmental costs were used as a yard-stick to consider what was fair and reasonable prices for competing private armaments companies.

Indeed, the origins of the costing and accounts system at the government manufacturing departments from 1862 was to have, "a thoroughly accurate and reliable statement of the actual cost of the guns and other things produced in the Government factories for the purpose of comparison with the prices at which they could be obtained by contract" (Morley, 1887, C 5116: 198, question 3504). It was by this method that the 'inflated' prices of the Elswick Company were revealed in 1862 leading to the premature termination of their contract with the War Office.

Hurst, in giving evidence to the Morley Inquiry in November 1886, stated that Balance Sheet No 2 "was instituted to show the cost of articles to compare with contract prices" (Morley, 1887, C 5116: 22 - Digest of Evidence taken). Hurst explained the objective of the No 2 Balance Sheet in 1862 was to satisfy complaints from Parliament and from representatives of the Chamber of Commerce:

"who came to see Lord Hartington and Lord de Grey" stating, "that it was unfair for us to publish this No 1 Balance Sheet to the World, showing merely the cost of what we produce based upon the expenditure voted by Parliament without taking into consideration those items which they were obliged to bear". (Morley, 1887, C 5116: 195, question 3435)

Hurst clarified that "depreciation and interest rates is confined to No 2 Balance Sheet, it does not affect No 1" (Morley 1887, question 3435). The Number 1 Balance Sheet was merely a document showing charge and discharge effects of the annual vote by Parliament, and how it was spent. Any surplus balance was returned to the Treasury

(MUN/5/106/400/2, June 1916; Higgs, 1914: 79).

By November 1886, the capital account of the Arsenal was valued at £927,588, and made up of a valuation of 1859, "to which all the money since spent in plant and buildings had been added: this is subject to 10 per cent depreciation on machinery and 5 per cent on buildings" (Morley, 1887, C 5116: 22, Digest of Evidence). The No 2 Balance Sheet introduced in 1862 covered the estimated depreciation of buildings and machinery per annum, interest on investment and working capital as follows.

- depreciation on buildings 5 per cent²
- depreciation on machinery 10 per cent
- interest on invested capital 3½ per cent
- interest on working capital 3½ per cent
(which was taken at one fifth of annual aggregate expenditure of the government manufacturing departments)

There is no evidence to suggest that the 1862 reforms of the Ordnance Factory accounting systems were influenced by the contemporary reforms of company accounting as enacted by the 1862 Companies Act. The 1862 Act, along with the earlier 1856 Limited Liability Act, made limitation of liability of registered public companies "universally available in law" (Jones, 1981: 29). The Victorian companies legislation tended to be arms-length interference rather than rigid control. The exception to this was railway and banking accounts, which were more vigorously controlled by mandatory railway and banking legislation, for example the Bank Charter Act 1844.

² Later under the recommendation of the Internal Committee chaired by the MGO Major General Sir Frederick Hadden, (1909-11) depreciation of buildings was reduced from 5% to 3%. Hadden wished it to be reduced to 2½% but this did not meet with Treasury approval and the accepted 3 per cent was a compromise however. But to offset Treasury objections a review was planned for October 1914. This, of course, never happened due to the intervention of the First World War (WO 32/11212).

The Ordnance Factory reforms occurred in the post-Crimean War era which was influenced by reforms in the Army generally and by the need to enhance maximum efficiency within parsimonious budget parameters set by the Treasury. However, the reforms of both the Ordnance Factories on the one hand and companies legislation on the other were influenced by a society which began to call for better scrutiny of public monies and of shares. By 1866 public accounts in respect of government departments were standardised through reforms of the Exchequer and Audit Departments Act. The major differences between the reforms of the accounts of the Ordnance Factories and that of the 1862 Companies Act can be seen from the treatment of depreciation of capital assets.

The concept of depreciation in the private sector during the nineteenth century

This section concentrates on the concept of depreciation in the nineteenth century from the perspective of the private sector and the public sector Ordnance Factories. This is justified as the introduction of depreciation into the Ordnance Factories is crucial to the appreciation of other subsequent reforms.

The treatment of depreciation in the private sector during the nineteenth century posed major dilemmas for the Victorian entrepreneur. The philosophy of depreciation was well understood but the actual treatment of accounting for depreciation was something rather less scientific. Even in the early part of the twentieth century, Jones refers to Edward Holden, Managing Director of the Midland Bank, who in 1903 recorded in his diary that he had seen:

"Mr. Whinney Senior who came in to discuss with me the question of depreciation and investments. He said he thought the proper course would be for the Bank to take a sum off their reserve fund, corresponding to the depreciation, but I [Holden] pointed out that there was no

necessity for us to do that." (quoted by Jones, 1981: 117)

Hurst considered that depreciation was more a matter of speculation, and suggested that depreciation was "an estimated charge, adopted in order to produce a result which might be considered to harmonise with trade prices" (C 5116, 1887, question 3464). Hurst clarified contemporary trade practices as follows:

"I know that the trade talk a great deal about depreciation and interest, but I found when my inquiries have been in this direction, that it is a mere matter of expedience what they write off for depreciation, that in a good year they will write off, we will say, 10 per cent or 7½ per cent, and in a bad year they will write off nothing." (C 5116; question 3641)

Again, Hurst clarified this statement concerning depreciation and bad years, suggesting trade would not average depreciation say at 5 per cent, but would write nothing for that year (C 5116: question 3465).

Depreciation had been introduced into the accounts (no.2 balance sheet) of the Ordnance Factories in 1862. This permeated into a consistent system of depreciation treatment until the First World War. It possibly did represent speculation in its calculation, but the evidence portrays a more standard and regularly used system than was apparent within the contemporary private sector, including the Victorian railways.

The 1911 Company Secretary's Directory defined depreciation as:

"... the diminution in value of an asset due to:

1. Wear and tear, or exhaustion of subject matter;
2. Natural causes, occasioned by the effluxion of time;
3. Obsolescence owing to inventions and general progress of mankind."

Despite the prevailing lack of consistent treatment with the write-off of depreciation charges, the Directory considered that "depreciation must always be regarded as a cost

of manufacture" (1911: 177).

However, the same Directory did note the point of existing practice where the directors of organisations contend that if their plant and machinery and other fixed assets are regularly maintained in a proper working order funded from revenue, then this would negate the reason for depreciation write-off in the first place (1911: 177).

The treatment of depreciation within the Victorian railway industry was also inconsistent and little guidance was given in earlier Victorian railway legislation. Chandler argued that the American metal-working industries in the 1880s "continued to use the railroad method of renewal accounting. They charged repairs and renewals to operating costs, and listed their assets either at original (historical) costs or at replacement costs" (Chandler, 1977: 274). In relation to depreciation and company accounts, it was only by the enactment of the 1948 Companies Act that depreciation charges and provisions had to be legally published in these accounts.

Thus there was no standardized format for the treatment of depreciation at this time. Since the early days of the railways, various railway companies either ignored depreciation, particularly of the permanent way, or charged depreciation to the capital account, rather than to the revenue account. Indeed numerous railway companies assumed that the permanent way would last 20 years or more without repair. Estimates of life spans particularly with British railway companies were always guesswork, a problem also noted by Hurst.

There are a number of reasons as to why the Victorian entrepreneur did not make any provision within the accounts of the business to annually charge for depreciation. Indeed, there was little incentive to change attitudes in this respect, Victorian corporate legislation was rather benign on this issue altogether. Other reasons

prevailed including the following points:-

- The main business structure with Victorian society was outside of limited liability status. That being so, even within limited liability status, the 1862 Companies Act made no reference to depreciation. Daunton states that: "Only in 1856 was it possible for firms to become joint stock companies with limited liability - even then few industrial concerns took advantage of the legislation" (Daunton, 2000: 74).
- The Victorian entrepreneur was continuously involved in his own business operations. The concept of family capitalism prevailed including in relatively large Victorian companies in the UK (Payne, 1967; Daunton, 2000: 74). Thus there was little interest shown in regular calculations of profits and statements including the value of capital assets.
- Also the nineteenth century entrepreneur was mainly not accountable for the profit of others.

The manufacture of the Armstrong Gun, Elswick Ordnance Factory and Royal Gun Factory

Evidence suggests that the new form of balance sheet, supplemented with Elswick's equivalent documents, exposed their prices as being too high. Anderson's evidence to Monsell both in 1862 and again in 1863, suggests a higher failure rate of Elswick manufactured Armstrong guns in testing at the Royal Arsenal. This is supported through evidence given to the 1862 Monsell Committee, by Captain Henry Gordon RN, principal storekeeper at the Royal Arsenal (who was responsible for the proofing and testing of passed ordnance), and Lt Col M Boxer RA, superintendent

of the Royal Laboratory. The Royal Laboratory tested ammunition of all calibres produced for the Armstrong gun both at Woolwich and at Elswick.

Because of these allegations, Monsell reconvened in 1863 in order to investigate the contract of the Armstrong gun further, which resulted in a second Parliamentary Select Committee on Ordnance (Monsell, 1863). Mr. George Rendel replied by letter defending the costings of the Elswick Ordnance Factory, and criticising Hurst and Anderson's figures and findings. He also criticised the balance sheet of the Royal Gun Factory. From Rendel's criticism it is obvious that the Elswick Ordnance Company did not itself use a contemporary balance sheet. Nor was the company enthusiastic about the Ordnance Factory No 2 balance sheet.

Anderson furnished a Paper in reply to this where he acknowledges that,

"The balance-sheet in question is the first submitted under the recent orders from the War Department on this subject, and from its novelty, together with the haste waged for its completion, is not so perfect nor distinct as it ought to have been, and which will be improved in the future." (WO 33/012, letter of 30 June 1863)

In Anderson's reply there is evidence to suggest that piece-working as used in the Royal Gun Factory was not a practice deployed at Elswick. This may also suggest that the Elswick Ordnance Factory may not have been manufacturing their guns using interchangeability techniques at this time.

Anderson described part of the costing process as follows;

"Another example ... is the item for tongs, for lifting 12 pounder Armstrong shells off the limber boxes. On this item, Mr. Rendel says, 'At page 28, making iron tongs for lifting 12 pounder shells for Ordnance Select Committee is charged at £505-13s-4d. The material used in the manufacture of these tongs is stated to have been of the value of only £24-12s-7d. So that in the manufacture of a common article of hardware, the cost of the article is stated at twenty times the value of the material used'."

In response to this Anderson states that

"This tong is a well finished article, with the part that grips having teeth cut perfectly concentric with the shell. The joint also is a well-constructed piece of workmanship and the gripping part is made to embrace two-thirds of the shell. As there was a considerable number to make, it was deemed advisable to prepare tools so as to produce them by machinery as much as possible. The expense thus incurred was considerable; 420 pairs were completed during the year, and a considerable more were in hand. All expenses incurred is included in the above total. The workmanship was done by piece-work at 11s 3d per tongs; the material cost about 9d. If more are required we now see a way of reducing the cost a little, and considering the foregoing circumstances the above price is not unreasonable. Mr. Rendel calls this a common hardware article. There may be some difference of opinion regarding the word "common" but these tongs are as good and sound as can be made, and will be much cheaper in the end than what I would call a common article." (WO 33/12: 5-6)

Anderson also commented that,

"In a large Government manufactory such as the Royal Gun Factory, there is a continual performance of trifling jobs, altercations, and other work that must be done to carry on the service smoothly, which, if performed by a contractor must be paid for, but in the Department this is not the case, such temporary help or assistance being usually done by those whose time is booked to orders properly authorized, it being understood that nothing is lost if done for the furtherance of the service." (WO 33/12: 6)

Regarding the preparation of the second Number 2 Balance Sheet, Anderson was confident it would be much improved, "and the accounts of the current year are kept in such a manner that in all probability the following balance-sheet may be nearly perfect, as so much fresh light is brought to bear on the whole subject" (WO 33/12: 6).

Again Anderson in attempting to redress Rendel's claims, that the prices from the Royal Gun Factory was not unreasonable, yet required further explanation on other grounds, including four items overlooked by Rendel. These were:

1. Artificers sent out to stations.
2. Taking the annual valuation of stock.

3. International Exhibition.

4. Pay and instruction of naval and military artificers (WO 33/12: 6).

However, Anderson did concede "where is the line to be drawn?" These items:

"involve general expenses, and where a principle of division is laid down, it must be carried out systematically, unless the item itself is introduced into the general charges, every order, large or small, must be treated alike; were it otherwise, it would open a door to all sorts of meddling with the accounts, and might lead to one being favoured at the expense of another." (WO 33/12: 6)

Accordingly, Anderson conceded if the current system was wrong, or until a better plan was devised then "we can only act according to the rule laid down, whatever it may be, leaving nothing to selection on the part of those who compile the accounts, but it seems to me more a question for the Accountant-General to decide" (WO 33/12: 6).

The proofing and sights for the Armstrong guns manufactured both under contract at Elswick, and at the Royal Gun Factory was tested and fitted at the Royal Arsenal Woolwich. Indeed the Royal Gun Factory was the finishers of all the guns whether manufactured at Elswick or Woolwich. Anderson defends the costings at the Royal Gun Factory to include:

"... the grinding of the interior of the guns to precise dimensions, generally to the thousandth part of an inch, finishing the outside preparatory ... beyond what is specified... As the guns were generally heavy ... it was necessary to provide ... lifting and handling and removing them from place to place, -- to insure absolute correctness ... and their sights ... to be perfect in the strictest sense of that word. The sights themselves .. which were worked upon during the year amounted to 37,529 and, considering the accuracy and finish, is of itself a formidable item." (WO/33/12: 6)

It would appear from this evidence that the Royal Gun Factory as a public department, was more advanced in its production, costing and accounting techniques as compared to the Elswick Ordnance Company. On the recommendation of the Monsell Report

of 1862, the War Office terminated their contract with the Elswick Ordnance Company, compensating them with £85,000 for loss of profit. This figure had been reduced from a recommended higher figure, for the non-return of certain machinery loaned to Elswick. *The Times* reported that a test of an 80 ton made at Woolwich and a 100 ton gun made at Elswick were "subjected to a comparative trial by the committee on ordnance at the proof butts in the marshes adjoining the Royal Arsenal, Woolwich" (*The Times*, 5 February 1862). The trials also tested gunpowder made at the Royal Gunpowder Factory and imported gunpowder from Westphalia. The Ordnance Committee favoured the performance of the Woolwich gun and the Waltham Abbey gunpowder (*The Times*, 5 February 1862).

The idea that all the Armstrong guns were required by the Army and Navy, was also reflected in evidence given to the 1863 Select Committee on Ordnance. Whiffin, in evidence to the 1863 Committee, suggested that a very large saving could be made to the country if this happened. However, Whiffin apparently gave this as an opinion and did not back it up with any data or other evidence. The Committee appeared to take some exception to this opinion, for example this point was made by Colonel Dunne in evidence to the Committee who, although he had the highest regard for Whiffin as an accountant, commented that, despite exchanges in correspondence, "I do not see very well how he could have given in the form of the return which he was asked to fill up, any report very different from this ..." (Monsell, 1863, question 5315: 2641, index 591).

Scott briefly records this episode, and states that:

"There were allegations that costs at Elswick were unduly high, and that money was being thrown away which could be saved if manufacture were kept in the hands of the Royal Arsenal at Woolwich."

Scott contends that "Armstrong was sacrificed, and in October 1862 the Elswick contracts were terminated" (1962: 30).

The reason for the failure of Elswick to retain its contract was due to the better performance of the Woolwich guns, and not, as Scott contends, because they "abandoned breech-loading" (1962: 30). Neither does primary source evidence support Scott's premise that Armstrong was sacrificed (Proceedings of the Institution of Civil Engineers, vol.68, 1881-82; vol.147, 1901-2).

Evidence given to the second Monsell Inquiry of 1863 referred to accidents with the Armstrong guns manufactured at Elswick and in service with the Royal Navy, whereas the Admiralty reported favourably with regard to the Woolwich manufactured Armstrong guns (Monsell Report, 1863: index, p.591).

However, Scott does suggest that the loss of the War Office contract for the Armstrong gun, encouraged the Elswick Ordnance Company to compete in the international armament industry. Quoting Armstrong, Scott records that: "From that time ... the firm had no alternative but to commence a new career based on foreign support, and it was by that support - and not by government patronage - that the Elswick Ordnance Works was established" (quoted by Scott, 1962: 31). Unfortunately, Scott did not give the source of this reference. However as Elswick previously had been a success as a civil engineering company under the directorship of Armstrong, and it was possible for the Company to revert to civil engineering. In fact the Elswick Company, as Armstrong of Elswick, entered the growing international arms market, which included both home and foreign naval orders for warships (Warren, 1989). Orders from the War Office were not forthcoming and thus between 1863 and 1878 Elswick, under Armstrong's directorship, produced and sold Armstrong

breach-loading rifled ordnance to America (including the Union and Confederate Armies in the Civil War), Peru, Chile, Egypt, Turkey, Italy, Denmark and New Zealand. In fact Armstrong's of Elswick came a close second in the international arms market to Krupp and by 1900 was perhaps the largest company in the United Kingdom (Warren, 1989: xiii; Wilcox, 1999: 60).

By the late nineteenth century, along with BSA, the Elswick Company were manufacturing bicycles through interchangeability processes. Scott's *History of Vickers* reflects a certain bias towards the Elswick Ordnance Company. This is a criticism of house histories generally, a point referred to in the first chapter.

Anderson succeeded Armstrong as Superintendent to the Royal Gun Factory. He gave the bulk of evidence to the 1863 Monsell Committee and successfully rebutted the Elswick defence. Anderson and his manager, Robert Fraser, were engineers. But it is apparent from their testimonies that they were expert with costing techniques, and, indeed could be associated as costing or efficiency engineers, as argued by Loft (1994: 118). Jones succinctly argued that it was those at the 'cutting face' who acquired the necessary skills to perform effectively (1981: 72). Both Anderson and Fraser are examples of this, Fraser was first appointed to the machinery department of the Royal Arsenal, then as manager of the Royal Gun Factory. His improvements to the Armstrong gun in terms of production quality, increased its cost efficiency, whilst lowering production costs where, "Time and labour are ... sacred in having fewer pieces to move from workshop to workshop ... combined with the employment of cheap labour, a Fraser gun can be made more cheaply than an Armstrong gun as originally manufactured" (Institution of Civil Engineers Proceedings, vol.78, part 4, 1883-4: 428). By 1868 the modified Fraser gun was being produced in steel. Fraser

also resolved most of the difficulties with Armstrong's original prototype breech-loading mechanism. This achievement was not mentioned by Scott (1962) nor by Warren (1989).

Fraser had adapted the production process of the Armstrong gun where with the rescheduling of labour, and the introduction of the conveyor belt assembly system, he could produce the gun faster, more efficiently and cheaper. The re-named Fraser gun cost £70 per ton to produce compared to the £100 manufacturing cost of the Armstrong gun. The Fraser guns were easier to produce and assemble. They withstood the severest of tests by the Woolwich inspectors. For example, two Fraser guns endured continuous test firing of 2000 rounds each before succumbing to stress (Hogg, 1963: 904).

The recommendation of the 1863 Monsell Report and the departmentalisation of accounts

The Select Committee on Ordnance of 1863 in part of its terms of reference, further examined the accounts of the Woolwich Departments which in the main included the Gun Factory and Laboratory and reported on the workings of the new systems generally. In particular the Chair of the Committee, William Monsell, asked whether "Mr. Anderson of the Treasury, who is the highest authority on this subject, has considered the question of different accounts at Woolwich and whether he has approved of them" (Monsell, 1863, question 5578: 279).

Whiffin replied that he "did not think that his attention has ever been drawn to the detail of the Army manufacturing accounts; he gave a general approval of the books in existence two or three years since, but I do not think his attention was ever

drawn to the principle of the accounts as now rendered" (Monsell, 1863, question 5578: 279).

Later in the proceedings Whiffin's opinion was sought as to whether the No.2 Balance Sheet could be called a commercial account (Monsell, 1863, question 5628: 280). Whiffin replied that it was "very difficult to make government accounts on commercial principles", which was then suggested by Colonel Dunne (a member of the Committee) that it would be difficult to compare commercial prices with government prices (Monsell, 1863, question 5623: 280). However, Whiffin gave the opinion that he did not "think there is very much difficulty in making a comparison of the prices charged by a private establishment as those of the government; that is to say, making a comparison for government purposes" (Monsell, 1863, question 5623: 281).

The index to the Monsell Report of 1863 summarised the accounts (Woolwich Departments) which included:

1. The Gun Factory;
2. Laboratory; and
3. As to the systems generally.

There was a problem in the recording of the accounts in the Gun Factory, particularly with reference to the cost of the 100-pounder gun and the distribution of the various labour and material costs under the various heads. Monsell recognised this difficulty in the Gun Factory "of clearly showing the precise cost, an account of the variation in the value of stock in hand (Monsell, 1863, questions 5337-5340: 591).

The Monsell Report of 1863 approved of "the adoption at Woolwich of the system of accounts recommended by the War Office" (questions 4085-6) but suggested that "the accounts at each department be kept separate and that the capital necessary

be borrowed from the Treasury at interest" (Monsell, 1863, index: 591).

The introduction of the balance sheet into the Woolwich Departments was praised by Monsell, who suggested that they "should be so distributed as to show the actual cost of each article to the country" (Monsell, 1863, index: 591). The report highlighted the success of the balance sheet in explaining that its objective was to "comply with certain representation that the expenditure should be distributed as to show the actual cost of each article to the country", but Baring reminded the Committee that "the attempt, though a great step in advance, is far from complete" (Baring, 5334 *et seq*). Different results produced by allotting the indirect expenses on labour only, and upon labour and material combined (in questions 5326-33, 5340) with expediency in the formation of a balance sheet, of its being definitely settled how the general expenses are levied in 5342-6 (Monsell, 1863, index: 593).

The 'gun problem' had been difficult to resolve. Before 1862 the accounts and finances of the newly reconstituted Gun Factory had been "in a very unsatisfactory state" (Monsell, 1863, questions 5342-8: 266-9). Baring had highlighted the problem of costing for the multi-calibred Armstrong gun, noting the difficulties in charging overheads to the differing artillery produced at the Gun Factory. Whiffin admitted that there was a gun problem, particularly with reference to the cost of the Armstrong 100-pounder gun, and to the distribution of the various labour and material costs under the various heads. This was recognised in the 1863 Select Committee Report on Ordnance. The summary of the report into the accounts of the Gun Factory emphasised the problem of "clearly showing the precise cost, on account of the variation in the value of stock in hand" (Monsell, 1863, index: 591; see also questions 5337-40).

The solution to the gun problem was provided by Hurst, who divided the cost accounts in the Gun Factory into three classes according to the calibre of the ordnance being manufactured, these being (i) heavy, (ii) medium and (iii) light. Each class of ordnance bore an appropriate percentage on materials for labour and machinery charges (Hogg, 1963: 874). Hurst's methods redressed the previous and simplistic system which was unworkable due to the increasing technology in artillery and ballistics science as reflected in the Armstrong gun, in factory production and in the changing systems of the division of labour. The transition of the manufacture of artillery at Woolwich from a workshop-based brass foundry to a factory production method, had not brought the support systems together, for example the accounts costings and other voucher systems.

The rationale behind the organisation and line structure of the Ordnance Factories still favoured a decentralised system. This too was reflected in British capitalism, particularly in the structure of family capitalism and partnership. Over the next two decades the systems evolved through a learning curve and, with the increased technology in artillery and ballistic science and the increased size in the Ordnance Factories, the idea of centralisation became more apparent.

The centralization of the accounting function at the Ordnance Factories

Loft stated that:

"To establish a comprehensive system [of costing] required a standardization and organisation of production which was found only exceptionally... To find out what it cost to make something required in many cases, combining factory records of production, and records from the accounts office which were kept independently." (1994: 118)

However, Loft does not give an example of a British company or organisation which

did this. But the example of the nineteenth century reforms of the Ordnance Factories is such an example, particularly after the centralisation of the ordnance establishments in 1887.

The basis of the Morley Report into the Workings of the Government Manufacturing Departments, of 1887, had its origins in an earlier inter-departmental committee report of 1879. This committee was appointed on 26 July 1879 "to enquire into the Clerical Establishment of the Manufacturing Departments (WO 33/34: The Manufacturing Departments Of The Army Reorganisation Of The Clerical Establishment.) The recommendations of this committee were based around the improvement in the pay and conditions of the clerical establishment, and advised the use of interchange between the Ordnance Factories clerical staff with that of the Naval dockyards and arsenals.

There was a marked difference between the Admiralty system of accounting and auditing compared with that of the War Office Manufacturing Departments. Within the Royal Dockyards the dockyard accountant was appointed from one of the principal officers. The dockyard accountant also fulfilled the role of local auditor. He was subordinate to the Dockyard superintendent, but reported directly in his role as auditor to the Board of Admiralty. His audit was accepted as final.

By contrast, the Accountant and Auditor of the government manufacturing departments was bound on the strength of the War Office directly, though located at the Royal Arsenal, Woolwich. The Accountant and Auditor was responsible for all the manufacturing departmental accounts, and he reported directly to the Assistant Accountant General. The Committee Report of 1879 concluded that the audit of the accounts, and balance sheets of the government manufacturing departments was more

thorough than the contemporary dockyard accountants. The Report continued "that, whereas there is a separate accountant for each Yard, there is only one Auditing Officer for the whole of our Arsenal Factories (Vote 12 - Woolwich, Enfield and Waltham Abbey), and formerly his sphere of duty extended to the Clothing Factory" (WO 33/34: 6).

The 1879 Committee Report complimented the professionalism of Hurst and stated that they "wish to record their opinion that his duties are of a very important and responsible character, and it is regretted that he has no assistant of adequate rank and position who is learning his duties and qualifying to take his place in the event of absence or retirement" (WO 33/34: 6).

Hurst's salary in 1879 was £500 pa, and had not altered for ten years since being fixed in 1869, when graded at the then 2nd Class of the War Office. His staff at Woolwich consisted of:

"One Second-Class Assistant at £250 pa

Two Lower Division Clerks at £90 to £250 pa

One Writer at 34s a week." (WO 33/34: 6)

Costings and the evidence of Hurst to the Morley Committee, November 1886

The 1887 Morley Committee (C 5116) investigated the workings of the government manufacturing departments in three broad areas:-

- the lack of coordination and communication between the individual government factories
- the quinquennial changes of superintendents
- inspection.

The lack of co-ordination and communication between the individual government Ordnance Factories had been allowed to develop due to the independent historical origins of each factory, which had been established quite separately. In terms of the 1863 Monsell Report, the decentralised administrative and financial structure was favoured because it fitted an already decentralised factory organisation which, in terms of the defence procurement needs of 1863, proved to be effective. By the mid-1880s, however, it was now evident that considerable diseconomies were apparent due to this decentralised structure. These were reiterated to the Morley Inquiry by each of the military superintendents of the Ordnance Factories. The interior economy of each government manufactory, particularly in relation to the conditions of employment and the payment of overtime, varied considerably between each department. Apparently there was some dissatisfaction among the employees from each manufacturing department who were graded differently for similar work. Some workers were in receipt of non-monetary benefit in some factories, for example free breakfasts at Woolwich, whereas in other departments, workers received no such benefit at all.

Again, Hurst also gave examples of a divergence between government manufacturing departments concerning the administration of accounts. The Accounts Branch at the Gunpowder Factory at Waltham Abbey would consolidate the financial structure of its separate operations, whereas at Woolwich separate accounts for each operation were maintained. Hurst argued for the centralisation of all accounting and financial functions of the manufacturing departments.

Other overlapping issues prevailed such as the cost of maintaining the upkeep of the infrastructure of each factory, particularly road cleaning, gardens, security and divine service. Problems also arose in respect of experimental artillery produced at

the Gun Factory for use by the Royal Laboratory and later modifications. This produced elements of double-accounting and duplication.

All these issues had developed since the earlier Monsell Report of 1863, particularly in respect of the evolution of ordnance and ballistic science. Since the 1880s the type of warship developing in the Royal Navy required a defence system which had never been contemplated by Monsell. The first iron-clads were born, together with the attendant weapons systems.³

Much of the evidence given by Hurst to the Morley Committee centred around his role as Chief Accountant and Auditor. His evidence gives a clear picture of the costing system within the Ordnance Factories through apportioning indirect expenditure to cost centres. In terms of contemporary accounting practice, the system in the Ordnance Factories appeared to be more advanced than in the contemporary private sector.

Mr. Carbutt, a member of the Morley Committee, questioned Hurst regarding his role as an auditor and whether the auditor was responsible for costing. Hurst stated that it was the individual factory manager who was responsible for costings (C 1887: 194, questions 3402, 3403).

The managers of the individual manufacturing departments were civilians and were responsible for the costing within their factory. Hurst stated that it was not his role to challenge any costings. But Hurst did remind the Morley Committee that the superintendent had authority over the manager, and therefore could intervene in any of the manager's decisions, if it was thought necessary:

³ HMS Warrior, the first steam-driven iron-clad battleship in the Royal Navy, was first commissioned in 1860. J.G. Whiffin served as paymaster on HMS Warrior from 1867 to 1870 (ADM 19611).

"of saying ... 'you charge too much for this gun and too little for that. Why have you charged certain items of expenditure within your workshop, to any general items, instead of to this special item?' I think the power remains with him [the superintendent]. I do not see how the auditor is to control anything of that kind." (C 5116, 1887: 194, question 3407)

Carbutt, further questioned Hurst in relation to the system placed on managers in the government manufacturing departments, and whether the same reliance would be placed on a manager of a private engineering company. Carbutt in particular identified both Armstrong and Whitworth as comparisons. His line of argument was whether the assessed costing decision by the manager was internally checked, or externally audited in any way. Hurst reiterated his previous comment that the manager of a government manufacturing department had sole responsibility for this. Hurst did remind the Committee that the manager was subordinate to the superintendent for any discrepancy in the first instance, and not to the auditor. However, Hurst in his position as chief auditor had no power whatsoever to check the costing decisions made by managers of government factories.

Nevertheless, Hurst did clarify his role as auditor that he did have the authority to check and compare the costings of each gun in the current year, with the costings of previous years. In Hurst's opinion, the same system and reliance of the manager was similar in the private sector, including at Armstrong and Whitworth. Both companies also left such decisions to the integrity of professional managers (C 5116, 1887: 194, question 3405).

Hurst confirmed that indirect charges were accounted for annually per gun and not monthly, as were materials and labour. Carbutt again in his questioning of Hurst, attempted to draw comparisons between government factories and the private sector. He questioned whether indirect charges at the Ordnance Factories were not charged

with the outlay for any particular month:

"... to which extent the government is in a better position than the private manufacturer would be, because he would charge his indirect expenses every month against the article." (C 5116, 1887: 194, question 3410)

Again Hurst replied that this in practice would not be the case. Hurst explained that, taking as an example the month of April, the government factory makes up the cost which has accrued during the month for materials and wages:

"... which are charged in the cost ledger, to the guns which were being produced, but the month's work would go a very little way towards completing the order. Therefore, month by month, there would be no difference I apprehend between the private manufacturer and the government factory, so far as direct charges are concerned."

Hurst suggested that to undergo a scheme as suggested by Carbutt would:

"... have 12 operations to go through in the year without any great public advantage, so far as I can see, besides which many of our indirect charges could not be ascertained monthly." (C 5116, 1887: 194, question 3410)

In fact Hurst suggested that to account for indirect costs on an annual basis was more cost effective in clerical work and time.

Hurst clarified the status of military officers attached to the government manufacturing departments, including the military superintendents at the various departments who, although receiving two salaries, one military and one civil, were only superannuated on their military salary. This was obviously not budgeted into the estimates for the Parliamentary vote for government factories. Neither did the War Office have to pay rent for the land on the site of the Royal Arsenal, a point made earlier. In fact, in the strict legal sense the War Office were squatters on Warren Marsh. Obviously both categories relating to military salaries and rent-free land were schemes not enjoyed by competing private sector contractors.

At the end of the financial year the total amount of overheads was made up

and allocated pro rata as a percentage on the direct wages of all the articles produced (C 5116, 1887: 567, Appendix XVI).

The method adopted at the government factories was described in Appendix XVI of the Morley Report. Each job was identified by a 'work mark' to which the charges for wages and material required in their production were booked. Material for the various trades were drawn from the store upon demands showing 'work marks' for which the articles were required. These charges were then prepared in monthly abstracts and then posted to the cost ledger. All the principal accounts were kept on double entry system (Morley, C 5116, 1887: 566-7).

This system is very similar to the "shop-order system of accounts" which improved the control and flow of basic cost accounting devised in America by Metcalfe (Chandler, 1977: 273). Metcalfe argued that the basic managerial problems in America during the 1880s "were co-ordination and control" where in many cases the process of manufacturing resulted from records "too often kept by memory" (Chandler, 1977: 273). It would appear that the British Ordnance Factories had resolved this problem.

Hurst in evidence to the Morley Committee described how the cost of an article was arrived at. This was through the material expended and the work input performed as ascertained daily, recorded by timekeepers. The derived cost was debited monthly together with indirect labour against the article. According to Hurst, the indirect percentages were about 50 per cent on the direct labour and were charged on the labour "as the result of careful deliberation" (C 5116, 1887: 295, questions 3414 to 3428. See also summary of evidence given by Hurst, p.22).

Hurst, in defence of the system at the government manufacturing departments,

stated that:

"The prices of articles made at the Arsenal, though often under those of similar contract articles, are accurate. It would require a conspiracy of several responsible men to put part of the cost of one article on to another, and there is too much risk and not sufficient motive for anyone to do this, as the chief officials' pay is the same whatever the price of the article ... The best method of testing the accuracy of the accounts is by local inquiry. The local accountants' would draw the attention of the superintendents to any inaccuracy in charges against articles. To prevent fraud, I [Hurst] compare the prices of articles in the year just ended with the prices in former years, and any discrepancy must be explained by superintendents. It would be almost impossible to cook the accounts for two or three years running." (C 5116, 1887, summary, p.23)

He further explained that:

"To find out what the cost of a gun this year comes out, I bring it into three items, labour, materials, indirect expenditure; if I find any serious difference between these items, I draw the attention of the Director of Artillery to it, and we get an explanation from the superintendents." (question 3529, p.199)

The Ordnance Factory cost clerks

The factory managers at the government factories and the superintendents were not accountants. However, there is evidence that costings were being conducted quite accurately and effectively at the government manufacturing departments. The actual 'costers' may have been the mechanical writers who were closest to the problem. The term writer was a grade of clerical worker in the civil service or a naval clerk. These mechanical writers equated to the contemporary cost clerks as described by Loft (1994: 118).

The Committee of 1879 on inspection found the quality and performance of writers very impressive. The Committee recommended that certain writers should be allowed to be given superannuation along with assistant foremen and foremen, and

the latter should interchange with the role of writer, so long as they satisfied the appointments board by holding the requisite Civil Service Certificates (WO 33/34: 5).

It is possible that by 1887, many mechanical writers had been recruited from the assistant foreman and foreman grades of the Ordnance Factories. Therefore they could have an in depth knowledge of engineering principles and costings.

It is interesting to relate this development in the British Ordnance Factories with contemporary development of large American business, notably engaged in metal-working. Metcalfe had advocated at the Springfield Federal Armory his voucher plan to be administered by the foremen and senior supervisors. This was criticised by Metcalfe's contemporaries, Taylor (of the Midvale Steel) and Anderson, who argued that foremen had neither the time nor interest to fill out the vouchers correctly. The view of Metcalfe may be too simplistic. Braverman argues that the increase in the need for clerical workers was a symptom of scientific management. He refers to the early industrial enterprise which employed few clerks, "generally fewer than half-dozen in even the largest firms" (Braverman, 1998: 203). However, unlike the British Ordnance Factories, who recruited their mechanical writers from the supervisory and foreman grade, the American metal-working industries had externally employed specialised clerks and timekeepers to "collect, record and disseminate the information needed for costing and co-ordination" (Chandler, 1977: 274). Chandler commented that by the 1890s these clerks "had become the first 'staff' employees in a number of metal-working factories" (Chandler, 1977: 274). It is argued that a similar system had occurred earlier in the British Ordnance Factories, where line senior employees had been internally selected and promoted as 'staff' employees.

There is no evidence in the PRO SUPP series to demonstrate how a paper trail

from production to the payment of wages was attained. But by a scrutiny of the existing committee reports such as Morley, in the description of the division of labour on the shop floor of the Gun or Rifle Factories, and utilising what is known about contemporary pieceworking payment systems generally, the following description may be made.

The daily output of each worker was inspected by a viewer and each component passed was entered on a voucher. The number of passes on a worker's voucher was conveyed into current terms by a writer and then issued to the pay office. The system was audited by the supervisor of a section who would randomly and frequently inspect the viewer's passes and possibly conduct checks of a workman at his bench. Any errors or differences would be corrected. The foreman could also double-audit the supervisor, viewer, worker output process, as could the factory assistant manager or manager. A worker had the right of appeal against any decision, to the superintendent of the factory.

Sir Charles Harris, in evidence to the Sub-Committee of Inquiry on the Ordnance Factories in January 1919, praised the Woolwich system of accounts as laid down before 1914 of the independent record of the work-taker and of the stocktaking of semi-manufactures (work in progress). There is some suggestion in the evidence given by Harris that these systems had deteriorated during the period when the Ordnance Factories came under the governance of the Ministry of Munitions (1915-19). This is pursued further in Chapter 8.

However, Harris pointed out that "prior to 1915 the system was under the

CSOF. A civil assistant (Mr. La Brooy⁴) was responsible for the whole business of the factories. Under him was another civil servant in charge of cost accounts who had been trained in the particular form of accounts used by the factories. The officer who actually kept the books was thus one of the assistants to the Chief Assistant to the CSOF (MUN 4/6375).

According to Harris:

"The main object of cost accounting was to save the country's money so far as possible. Accounts ought to be so kept and the results ought to be so analysed and brought before the Controlling Authority that that Authority knew quite definitely what was happening." (MUN 14/63751)

In relation to the pre-1915 Woolwich system of accounting, Harris said that:

"there should be no difficulty in giving from the work-taker's books, in which the labour was now recorded, an analysis of the time spent or the wages earned or anything of that sort, so long as the managers at Woolwich could use it when they had got it." (MUN, 4/63751)

However, Harris considered that the extraction of the costs from the books could be simplified "by appropriate arrangement of the work in the shops, e.g. by finishing a run of one kind of work right out and then changing over to another, so that no question of semi-manufacture would arise" (MUN 4/6375).

The government manufacturing departments and double-entry bookkeeping

As previously mentioned, Whiffin confirmed that DEB was not used in the government manufacturing departments in July 1862, but DEB was used as an

⁴ Justin Theodore La Brooy CB: civil assistant to the CSOF. Educated Corpus Christi College, Cambridge: Honours Classical Tripos 1880. Appointed Higher Division Clerk, Royal Gun Factory, August 1881. Appointed a staff officer 1891, civil assistant July 1900. Appointed a representative of the War Office on the governing body of Woolwich Polytechnic, September 1904. Appointed CB 1916 (War Office Staff List, 1919: 389).

accounting system in the Navy manufacturing departments (Monsell, 1862: 6, questions 127 to 130).

Hurst described how the then Secretary of State for War, Lord de Grey, sent him to the Royal Arsenal at Woolwich. Here Hurst implemented the necessary documentation and canvassed it with the various Superintendents' and with the respective clerks, in order to make the system work successfully.

"I had to draw up a statement to show how all the details could be worked in week by week and month by month and to show them how the double-entry books they might make monthly entries, and by these means... There is a check within itself in this double-entry system; and instead of leaving it to an indefinite period to work out the value of the material, for instance, especially at the end of the year, or at any time they liked, or that they had time to do it - month by month every item of material issued is valued and charged to the proper orders to which it is appropriated, and month-by-month the wages expended in the Department are also charged to the work upon which those wages have been expended; so that month-by-month the amount for any expenditure of that nature is debited to the work performed in the month; thus the expenditure month-by-month will be equal to the debit to the Cost Ledger month-by-month, and where production is going on for 12 months, the 12 months themselves will agree also." (C 5116: 193, question 3383)

Hurst confirmed to the Morley Committee that, the original double-entry system at the government departments was still operating very successfully after over twenty years, and was still totally accepted by the various superintendents. Their only concern was that to operate the system was very labour orientated, in terms of clerical labour. Hurst remarked that he believed "that the present system is as good as any systems that can be applied or that is applied in any of the large establishments in the kingdom" (C 5116, 1887: 193, question 3383).

Regarding double-entry book-keeping, the system was not universal in the private sector, and many commercial institutions were using single entry methods of financial recording as this reduced labour costs. Also there was no corporate legisla-

tion to enforce DEB (Corey, 1840, ch.IV: 46-9; Jones, 1981). This situation may have prevailed until the First World War. Single-entry book-keeping, or journal entry appeared in numerous texts in the nineteenth century from Corey 1840 to Lisle 1899. Many private engineering industries engaged in munitions production sub-contracted much of their work to smaller independent engineering workshops where single-entry book-keeping was common (see Warren, 1998: 182 for an example of a lack of an accounting system at the Cyclops Steel Works - also see Chapter 8). The accounting syllabus taught at the Army Class, London School of Economics (LSE) from January 1907, included single-entry book-keeping (LSE, 20.3.30).

Hurst had advised the Morley Inquiry that the system of accounting within the various government manufacturing departments could be improved, however. The prevailing system in 1886 did cause inconsistencies due to the existing decentralisation of the Ordnance Factories. Evidence of this had also been given to Morley by the separate superintendents of each Ordnance Factory.

However, Hurst, although recommending the centralisation of the accounting function, recognised that it would also involve wider structural issues. Hurst also identified the need for a supreme Director General of Ordnance Factories (DGOS) to have overall charge of all the Ordnance Factories. He recommended a consolidation of the Stores Department. In his evidence to Morley, Hurst referred to the last accounts presented to Parliament which showed that stores to the value of £300,000 were maintained in each of the three stores at Woolwich. Hurst considered that the stores structure at Woolwich was similar to "a Joint Stock Company depending on dividends, I am confident that the Directors would never consent, for economical reasons to having a Stores department kept up for each" (Morley, C 5116, 1887: 202,

question 3586).

Hurst and the recommendation for a centralised structure of the Ordnance Factories

Until 1887 there were four quasi-autonomous stores branches which supplied the government manufacturing departments.

- A military stores department under the Commissary-General of Ordnance
- Three separate Stores Departments for each of the Manufacturing Departments at Woolwich.

However Hurst realised that any change could increase his responsibilities. Even at the time of giving evidence to the Morley Inquiry, in November 1886, Hurst stated that he was entrusted with an annual amount "not far short of ten million sterling" (Morley, C 5116, 1887: 202, question 3587).

When assessing Hurst's evidence referring to stores accounting, it must be borne in mind that his recommendation was far more advanced than the contemporary private sector. Until well after the First World War, both chartered and incorporated accountants, including those specialising in audit, showed little interest in stores accounting. The point was referred to by Webster-Jenkinson in a lecture to a Bristol audience of accountants in December 1918 when he stated, "As a general rule the auditor bothered himself very little about the stores accounts, regarding it as a works matter" (*The Accountant*, 18 January 1919: 45). Sir Mark Webster-Jenkinson had been Director of Cost Accounts in the Ministry of Munitions during the First World War.

Contemporary with the Morley Inquiry, was Lord Randolph Churchill's Select

Committee on Army Estimates in 1887-88. The final report itself recommended no change in the existing system other than:

"It is desirable that the House should authorise steps to be taken to secure an independent professional examination and audit of the Expense accounts of the Army Manufacturing Departments, and of the books on which those accounts have been based." (BPP 216, 223, 232 and 259, 1887, Fourth Report: Hogg, 1963: 873)

Generally however Lord Randolph Churchill's Report was satisfied with the existing system of accounts as it was simple to operate and sufficiently accurate in respect of financial reporting of the Ordnance Factories to the society which they operated in during the later nineteenth century (Hogg, 1963: 873). On acceptance of this recommendation, Messrs Whinney and Waterhouse were duly appointed as auditors. Whinney and Waterhouse recommended a special format for the final accounts of Ordnance Factories. However the 1889 Army and Navy Audit Act, altered the method of Parliamentary provision of the Ordnance Factories Vote (originally Vote 12 but, after 1889, Vote 9) to be consolidated into one balance sheet and account, rather than the presentation of individual army and navy Ordnance Factory accounts.

Morley tackled the problem of the decentralised structure of the Ordnance Factories and in 1890 the complete system was reorganised on a centralised system. Four years later the Secretary of State for War, Campbell-Bannerman, introduced an eight-hour day for all government workers, including those at the Ordnance Factories (the exception being the Royal Gunpowder Factory). The success of an eight-hour day at most of the Ordnance Factories could only be achieved satisfactorily with a centralised system. The question of the eight-hour day is covered in Chapter 7. A uniform system allowed for economies to be made in the deployment of staff and the actual control of expenditure to be obtained. The new office of DGOS (later to be

restyled the Chief Superintendent of Ordnance Factories [CSOF]) now had total control of factory production. The superintendents of each factory were allowed access to the records however.

Cost accounting on a centralised system in respect of labour was based on the records maintained by a team of work-takers, immediately subordinate to the Principal Clerk in charge of the centralised Works Account Branch. Previously this had been compiled at each individual factory.

An Inter-departmental Committee of enquiry of 1903 presided over by a Treasury official, Mr. F.W. Webb, investigated the whole system of cost accounting in the Ordnance Factories. There was a clash of opinion between the Chief Mechanical Engineer of the Ordnance Factories, Mr. (later Sir) H.F. Donaldson and an independent accountant Mr. H.J. Morland (see Chapter 3), later a partner at Price Waterhouse. Donaldson "attached much weight to the system of cost accounting which would be of assistance for administrative purposes" (Hogg, 1963: 920-1). In order to achieve this Donaldson suggested that the weekly expenditure should be processed when it occurred, and the necessary returns made simultaneously in order that any investigation or diagnostic decision be made quickly. Also Donaldson wanted work-in-progress valuations made weekly, and not monthly, as was the current practice.

But the Committee was swayed by the argument of Morland, who had made an independent assessment of the system used in the Ordnance Factories, compared to the system practised in the private armaments industry. Morland was generally satisfied with the cost accounting systems at Woolwich in 1907 and appreciated the absence of profit considerations due to the different requirements needed in the preparation of Parliamentary sections rather than for a company trading, profit and

loss account together with a balance sheet (*History of the Ministry of Munitions* (nd), vol.VIII, ch.1: 17).

Morland's findings were raised again in January 1919 at the Costs Sub-Committee of the Committee of Inquiry into Royal Ordnance Factories. Sir Charles Harris, in defending the Woolwich system of cost accounts, suggested that the system had deteriorated during the First World War when the Ordnance Factories came under the overall administrative control of the Ministry of Munitions and not the War Office (MUN 4/6375, a point noted earlier in this chapter and which will be more fully explored in Chapter 8.

The official history explaining the Webb Committee's findings some twenty years later described the recommended system put forward by Morland:

"... with recommending the adoptions of more accurate systems of allocating machinery charges, in common commercial use, by which the work done at each machine bears an appropriate charge estimated to cover depreciation on that machine, cost of its maintenance and the power it consumes."

But in coming to this recommendation, the Committee appreciated the difficulty of:

"the omission of charges for interest in obtaining comparisons between Ordnance Factory and contract prices, but came to the conclusion that such comparisons would not be facilitated, but rather the reverse, unless the sums included in factory accounts for interest were calculated at a commercial rate of interest on a figure representing the commercial value of the factories." (*History of the Ministry of Munitions* (nd) vol.VIII, ch.1: 17)

The evidence by Morland may have over-emphasised the allocation of charges for machinery use, described as in common commercial use. This system was by no means universal in 1903. But the problems of commercial valuations of factories had been a problem stated previously in the Morley Committee of Inquiry. Donaldson's scheme worked well for the Ordnance Factories, and was a scheme widely used in

engineering construction.

However, by the turn of the century, the Ordnance Factories represented efficient organisations, which had evolved over the previous fifty years from workshop based units to one of factory production. This included reforms, cost and financial systems of control, the production process (interchangeability), the introduction of forms of scientific management. These reforms surpassed any other system in the contemporary private sector, in the United Kingdom. The Ordnance Factories provided at least one example in Britain where records of production and records from the accounts office were consolidated and costs could be found. Indeed, the Ordnance Factories were examples of centralized organizations, and where a comprehensive system of standardization and organization of production was in existence. This appears to have been unique in Britain at the time.

Much of this transition and reform had resulted from internal rather than external influences, through engineers and civil servants employed by the War Office, rather than through entrepreneurs or accountants. This success continued until the end of the Second Anglo-Boer War in 1902.

Conclusion

This chapter has explored the reasons and origins of costing and DEB within the management structure of the government manufacturing departments from 1862. In essence this has been an attempt to reinforce the overall argument that the development of public sector management, as was apparent from the Ordnance Factories, may have reflected a more professional management structure than the contemporary private sector.

There is no evidence to suggest that these reforms of the nineteenth century were removed. These reforms included three interlinking concepts:

- Costings and DEB.
- Production process and control (interchangeability)
- Labour relations and scientific management

The Ordnance Factories were the catalyst of reforms within the British engineering industry generally because of the introduction and acceptance of interchangeability, the growing use of scientific management. Also the fact that the Ordnance Factories themselves were not ossified in family culture and capitalism, nor were they subject to a restrictive craft union dominance must be major considerations why such reforms did not penetrate the private sector in the nineteenth century (Payne, 1967; Loft, 1994: 118; Chandler, 1996). Also, the Ordnance Factories, along with the Admiralty shipyards and dockyards, were flexible enough to adapt to changes in technology, both with the means of production and with the end product itself.

CHAPTER 5

‘Uniformity, Simplicity and Solidarity’:

**The Origins of interchangeability in the US Armories
and its relationship with the British
government manufacturing departments**

Introduction

The aim of this chapter is to explore the development of interchangeability from the American federal and private armories and the influence this had with the establishment of the Royal Small Arms Factory at Enfield from 1858 onwards.

This chapter leads on from Chapter 2, which assessed the concept of the 'soldier-technologist', from both the American and British perspectives. Some clarification is given to the term 'American system of manufacture' which Hounshell states was not a phrase used either by the American or British participants of the time (Hounshell, 1984, Appendix 1: 333). However, the process of manufacture by interchangeability may have had its origins in earlier French enlightened thought, as there is evidence to suggest a French system in the late eighteenth century. Again it is known that Henry Maudsley, Samuel Bentham and Marc Brunel produced ship pulley blocks through an interchangeable production process from 1805, the 'Portsmouth system of manufacture' and Brunel senior produced Army footwear by the same process from 1812 (Cooper, 1984). These earlier sources are discussed further in this chapter.

The terms 'interchangeability', the American or Portsmouth system of manufacture relate to a mass production process and it is often thought that such systems can only exist in a factory-orientated production system. However, there is evidence to suggest that mass production can also exist in small-scale units. Examples of this are seen in the nineteenth century in the sweated industries of the Victorian economy. These trades included many domestic orientated businesses employing mainly women and children, and homeworking which was described in Mayhew's mid-nineteenth century contemporary research into London life. Indeed, the Royal Laboratory, until

the mid-nineteenth century, used women outworkers on a large scale in the production of cloth cartridges. Again the practice of women outworkers was evident as a major means of mass production in the manufacture of military, naval and Post Office uniforms in the nineteenth century at the Pimlico-based Royal Army Clothing Department Factory.

Much of the Birmingham gun trade produced small arms in local craft units and Behagg referred to mass production in small arms manufacture outside of a factory system in England from 1790 to 1815 (1998: 1-15). This system was the major source of supply for the British Army and Navy engaged in the French wars during this period. However, a process of interchangeability producing repeat, long-run production cycles requires more of a factory-orientated production system and semi-skilled / unskilled labour as opposed to craft labour.

The emergence of interchangeability within the American Federal Armories from 1830 onwards does not mean that they produced on a factory system. There is evidence to suggest that this did not occur until the American Civil War (1861-64). Both the Springfield and Harper's Ferry Federal Armories still employed a craft-orientated workshop culture, though there was a transition of change from the 1830s until the American Civil War. Both interchangeability, together with its technology as introduced into the Federal Armories, interacted with the craft culture that already existed until 1861. This was more prominent at the Harper's Ferry Federal Armory than at the Springfield Armory.

However, the process of interchangeability in the production of small arms manufacture requires large-scale, repetitive and continuous production. The component parts of an American Mk1 Springfield rifle-musket and a contemporary Enfield

Mk1 rifle musket of 1858 interchanged with other rifles of the same pattern. This point in relation to the Enfield rifle musket was noted by a railway engineer in 1862, who suggested that such a process of manufacture made the craft armourer redundant.¹

The system of small arms manufacture to equip standing armies is more efficient and reaps the benefits of economies of scale. This was an attractive proposition for both the American and British governments. It was supportive of the prevailing philosophy of economic liberalism. In terms of government armories and factories deployed in munitions production, the introduction led to other internal reforms which further increased the efficiency of the state-owned factories without any extra expenditure from public funding.

The method of interchangeable production revisited Britain at the 1851 Great Exhibition when American armorers displayed a range of small arms produced by this method. This caused some embarrassment to the British establishment as it revealed the backward-looking military small arms manufacture, which was represented by an anachronistic small-scale craft gun trade. Yet the road to reform still moved slowly. Three years after the Great Exhibition, the government of the day established a Parliamentary Select Committee in 1855, authorising a Board of Ordnance delegation to visit the American federal armories. In the meantime the Crimean War had begun, which revealed the inadequacies of British military small arms and artillery in the field, compared to the advanced standard of the French armaments.

The lessons were quickly learnt and, on the recommendations of the Molesworth Report together with the failure of British small arms in the Crimea, the Royal

¹ See J Fernie, 'On the manufacture of duplicate machines and engines', *Minutes of the Proceedings of the Institution of Civil Engineers*, XXII (session 1862-3): 604-5. See also Rosenberg (1969: 63).

Small Arms Factory at Enfield was built, becoming operational in 1858.

This chapter first explores the origins of interchangeability within the American armories. Despite the early influence of interchangeability at the Springfield Armory under the superintendency of Roswell Lee, Springfield remained essentially a workshop rather than a factory until the American Civil War, a point made previously. For example, the use of Blanchard's lathes and interchangeability production methods did not totally eliminate craft workers (Cooper, 1991: 116). The workshop definition required a craft orientated process whereby the master craftsman controlled the place of work. Braverman elaborated this definition by suggesting that:

"In view of the knowledge to be assimilated, the dexterities to be gained and the fact that the craftsman, like the professional, was required to master a speciality and become the best judge of the manner of its application to specific production problems, the years of apprenticeship were generally needed and were employed in a learning process that extended well into the journeyman decades." (Braverman, 1998: 76)

The transition of a workshop-cum-master-craftsman-controlled environment into a factory system arguably reskilled or deskilled the craft orientated labour. More significantly, this reduced the craft labour control over specific production processes and problem-solving ownership. The deskilling of the traditional journeyman to that of machinist was, according to Braverman, "in Taylor's day among the most recent and certainly the most important to modern industry" (Braverman, 1998: 76).

Yet the introduction of the 'American system' into the British government manufacturing departments established Enfield and the Royal Gun Factory at Woolwich into a factory system in a relatively short period of time. The reason for this is that the Crimean War (1854-56) was the first 'industrial war' fought by Britain which involved the use of railways, of factory ships and civilians within the sphere

of the war. The Springfield Armory only adopted a factory system during the American Civil War under the superintendency of Colonel Alexander Dyer. The American Civil War was perhaps more devastating than the Crimean War in terms of casualties and collateral damage and reflected similarities which were to re-emerge, though on a much larger scale, during the First World War.

The onset of interchangeability in the government manufacturing departments established changes within the bureaucracy and management of each factory, which included:

- the change to a factory system almost immediately;
- the onset of pieceworking; and
- the establishment of scientific management.

This transition also altered the way in which the government manufacturing departments presented their accounts to Parliament. As military and naval procurement was supplied in a ratio of 2:1 by contract, the government manufacturing departments were under competitive pressure to be efficient. Changes in management accounting systems appeared to establish costings which could be analysed with contract prices. The role of the parliamentary accounts and the No.2 balance sheet was crucial to this development.

The focus on the American experience of the Springfield Armory and other reforms is important when assessing the managerial reforms of the British Ordnance Factories. Thus the first part of this chapter centres on the American system and then links in to the transition to the British Ordnance Factories from 1855.

Interchangeability - its French origins and development in America

In Chapter 1 it was suggested that the reforms of the Ordnance Factories were possibly influenced by the Franco-American reforms from the eighteenth and early nineteenth centuries. Indeed, it is very likely that the original concept of interchangeability entered a young America during the War of Independence through a French influence. However this was not fully utilised until the post-1814 era after the disastrous war with Britain (1812-14). From 1815 until the late 1840s the American military always relied on the 'French system' in revising and improving its military strategy and technology (Smith, 1987: 44).

The French influence is prominent in the two possible routes of interchangeability into Britain, the major influence being the American system of manufacture, though this itself most likely originated from the French. The second is the earlier influence of the "Portsmouth system of manufacture" (Cooper, 1984). The manufacture of naval ship pulley blocks by a process of interchangeability at Portsmouth Dockyard was undertaken by Samuel Bentham, Henry Maudsley and the French émigré Marc Isambard Brunel. However, Bentham may have been influenced in the process of mass-produced wooden ship pulley blocks due to his earlier experiences in Russia (Cooper, 1984: 193).

It is worth exploring the origins and operational procedures of the American Federal Armory at Springfield, Massachusetts. This is justified as important concepts developed from 1830 with the maturing of the US Ordnance Department, which was crucial to the development of interchangeability in the British government manufacturing departments. This transition gave the government manufacturing departments a major lead for forty years, compared to engineering in the private sector, an issue

explored more fully later.

The development of the US Army Ordnance Department from 1815 and the influence within the Springfield Armory was perhaps the genesis of the 'American system of manufacture' as it evolved in the United States during the nineteenth and twentieth centuries. The US Army Ordnance Department was the nucleus for the eventual rise of modern management in America from the years 1827 to 1856.

Other reforms in the American Army could have influenced later reforms within Britain. In particular the reorganisation of the US War Department during the 1820s may have influenced the post-1855 reforms of the War Department in Britain (later to become the War Office). But the direct contact was the Board of Ordnance visitation to the American Federal and Private Armories in 1855, given that the Portsmouth system of manufacture appeared to exist in isolation. With experiences both in America and Britain of a reformed War Department and the Army, it reflected that the public sector was perhaps the origins for future business and management reforms in the private sector.

The American experience developed from the effects of war with Britain between 1812 and 1814, which reflected previous peacetime inadequate funding, neglect and mismanagement. Military administration, including logistical support, was fragmented and decentralised. By 1814 the American field army suffered from poor logistical support and the inability of field commanders to unite in order to agree a general order of battle. The ultimate result was defeat. The American Army high command in the field had done nothing to impress the American taxpayer. Later, in the nineteenth century the British military system reflected a similar state of affairs, particularly during the Crimean War.

From 1815, attempts were made to reorganise and restructure the American Army. However, many American citizens were opposed to having a standing army, arguing that such an army could be a lethal weapon in a tyrant's hands, contrary to the rights of free Americans. The wider view perhaps is that the American taxpayer was not prepared to finance an army which proved to be so inefficient in the wake of the disastrous war with Britain between 1812 and 1814.

Indeed, the standing British Army survives, even in contemporary society, only by an annual Act of Parliament. However, the nineteenth century British taxpayer, like his American counterpart, was suspicious about financing a standing army which, from 1815 to 1854, was hardly ever engaged in the field for a major expedition, apart from the Sikh War in India and a number of colonial skirmishes. By comparison, the role of the American Army was vaguely similar. Until the American Civil War (1861-64), the role of the American Army was to garrison an ever-expanding frontier within a developing nation and actively engage in a number of minor Indian wars. The only war outside the American boundaries was the war with Mexico in the 1840s.

The US Ordnance Department

The beginnings of the American military culture began in the late eighteenth century when the new nation was nearly drawn into the war with France. This threat also awakened the idea of isolationism in America. The American War Department wanted to be independent of a reliance on imported armaments and ordnance, however the War Department needed a system whereby armaments, ordnance and munitions could be internally supplied at short notice. Also, the American military strategy required a system whereby ordnance equipment, including artillery and small arms,

could be repaired on the battlefield by military armourers, instead of the equipment having either to be discarded and replaced, or to be evacuated outside the battlefield zone for repair. The United States War Department was "willing to pay the very high costs involved because it wanted the upper hand on the battlefield" (Cowan, 1997: 80).

In 1815 the US Ordnance Department was reconstituted and given powers to make contracts and exercise jurisdiction over the production and procurement of all arms contracts passed from the Commissary General of Purchases to the Ordnance Department. Federal armories were established at Springfield in Massachusetts and at Harpers Ferry, Virginia. The Federal Armory at Springfield became:

"... the largest and among the most important prototypes of the modern factory establishment and its accounting procedures and controls were the most sophisticated in use before the early 1840s." (Chandler, 1977; Tyson, 1990)

The aim of the reformed Ordnance Department was to standardise and regulate armaments manufacture. The French influence is perceived through its attachment to the idea in part of the 'enlightenment' thought. The idea was to produce more arms across Europe so that your weapons systems were standardised. This was deemed to be rational because you could allocate budgets more efficiently and repair weapons more effectively.

During the war of 1812, American artillery and small arms had reflected a chronic disarray of calibres. The first Chief of Ordnance, Colonel Decius Wadsworth, complained in 1813 that "every superintendent selected whatever pattern and introduced whatever alteration his fancy suggested" (quoted in Roe Smith, 1987: 49). Wadsworth had worked with French military engineers and artillerymen, as well as Frenchmen in American service, notably Tousarde and Rochefontaine. Through this French influence, Wadsworth became acquainted with French military practice.

particularly Gribeauval's uniform system of artillery. On assuming command of the Ordnance Department in 1812, Wadsworth's philosophy was "Uniformity, Simplicity and Solidarity" (Roe Smith, 1987: 49). Wadsworth's influence was stamped on the US Ordnance Department until the American Civil War. As Chief Ordnance Officer, Wadsworth was strict. Ordnance officers were required to maintain accurate accounts and to enforce meticulous quality control through experiment, testing and inspection.

Contemporary with the war of 1812-14 and the reforms of the Ordnance Department in America was the pioneering work of John H. Hall. Hall was a New Englander who began his career as a cabinet maker and shipbuilder in Portland, Maine. He became a subcontractor to the Harper's Ferry Armory. Hall considered that it was possible to produce a new rifle with interchangeable parts, thus fulfilling the War Department's desire. Hall argued that his rifle could be manufactured under two complementary methods: the first through specially designed specific-purpose machines, and secondly by a series of gauges that could be used to test each part for uniformity. There were sixty-three inspection gauges "and an impressive stable of machinery" (Smith, 1987: 62-3). Here, "Hall conclusively demonstrated in 1826 that his rifles could be made with interchangeable parts, the first of their kind in America" (Smith, 1987: 63).

Hall received a contract from the War Department in 1820 which allowed him to establish a separate factory adjacent to the Harper's Ferry Federal Armory. Together with Simon North, who was an equally talented arms subcontractor from Middletown, Connecticut, another dimension was added to Hall's success. The process of interchangeability was proved when North adopted Hall's gauges and succeeded in making rifles whose parts exchanged with those produced at Hall's

factory at Harper's Ferry. Smith contended that "Hall and North provided tangible evidence of what could be accomplished by adopting uniform practices at two widely separated factories" (Smith, 1987: 62-3).

By 1822 Hall:

"... was able to report with considerable glee that he had reached the goal that Whitney and others had sought: 'I have succeeded in establishing methods of fabricating arms exactly alike, and with perfect economy, by the hands of common workmen'." (Schwartz Cowan, 1997: 81, quoting in Roe Smith, 1980: 51)

The success of Hall's method of manufacturing small arms by a system of interchangeability must not be seen in isolation. Contemporary with the success of Hall's system was the equal success of Thomas Blanchard's lathe design of 1819. Blanchard's lathe design solved two previous problems which otherwise prevented any process of interchangeability, particularly related to small arms production. The first problem resolved in this way was the development of a lathe to cut the material, and secondly to vary the relative position of the workpiece in order to cut away enough material in the right places to make the irregular object. Blanchard's invention created "an altogether new capability for the lathe, the ability to make a highly irregular three-dimensional object such as a gun stock ..." (Cooper, 1991: 81).

The development of the US Ordnance Department after the failure of the American field army in the 1812-14 war with Britain, together with the developments by Hall, were undertaken in a reactionary period of American history, as previously stated. The period in question during the 1820s is known as the antebellum period, "as the political programme put forward by Henry Clay in his 1824 tariff speech before the United States House of Representatives. Clay sought political measures to maintain and promote American industry and to eliminate foreign competition"

(Hounshell, 1984: 15).

The antebellum period was contemporary with the developments in American technology, when the American system denoted:

"an entirely different phenomenon ... the American system ... as defined by Eugene S. Ferguson, means manufacturing involving 'the sequential series of operations carried out on successive special-purpose machines that produce interchangeable parts'." (Hounshell, 1984: 15)

As observed by Hall, the labour process in production through interchangeability does not need a craft orientated skill, indeed it could be argued that interchangeability could have resulted in the 'deskilling' of labour. This was an argument with the development later in the nineteenth century of scientific management, in what Braverman called "the dissociation of the labor process from the skills of workers" (1998: 78).

However, a similar phenomenon occurred earlier in Britain with the experience of the Portsmouth production line. Part of Samuel Bentham's plans to enact the system of interchangeable production lines of ship blocks necessitated restructuring the working patterns and designs, whereby machine operating tasks could "cut across old craft boundaries instead of falling in with them" (Cooper, 1984: 222). Cooper argued that the "machine operation was likely to escape organised worker resistance", even if it did not thereby escape a generalised negative worker attitude. For example, Bentham deliberately reorganised the work in the metal mill and wood mill at Portsmouth Dockyard and did away with the traditional apprenticeships, not only in order to hire boys more cheaply to do the work of men, but also to diminish worker resistance to future innovations and rationalisation of a procedure (Cooper, 1984: 222).

The antebellum period in American history witnessed the reforms of the US War Department under Secretary John C. Calhoun and the reconstitution of the West Point Military Academy in 1819 under the superintendency of Sylvanus Thayer.

In 1817 John C. Calhoun became Secretary of War, a post he held until 1825. Like the British taxpayer, the American citizen wanted "more bang for his buck". With this in mind, and perhaps using the model of the Ordnance Department, Calhoun reformed and restructured the American War Department so that it extended and strengthened the military staff system. Previously, seven separate departments had administered the American Army on a role culture model (Handy, 1993: 185) with no overall objectives other than departmental objectives. A similar structure prevailed in Britain prior to the reconstitution of the War Office in 1855. The restructured American War Department included seven functional divisions which were in constant communication with each other.

A Corps of Engineers was also formed. Its role was to provide technical, administrative and logistical support to the US Army and to society generally. The Corps of Engineers was instrumental in constructing the ever-expanding American civilian railroad system.

The model of reform adopted by the US Army Ordnance Department, especially concerning the federal armories at Springfield and Harpers Ferry may have transferred to the private arms manufacturers, particularly Colt and Remington. Both companies competed with the federal armories for procurement of small arms to the American military.

Calhoun's managerial philosophy stressed the need for a centralised authority, strict personal and financial accountability and a functional yet elaborate administrative hierarchy. This type of bureaucracy would enable control and standardisation to be met where operational divisions and units were scattered along a vast geographical frontier. It would not allow local variation but would admit Congress to be provided

regularly with detailed costs and financial estimates and give the American taxpayer "bang for his buck". So Calhoun instructed Brigadier General Winfield Scott to draft a set of regulations which appeared as a first form in July 1821. The General Regulations for the Army became the 'arch stone' of Calhoun's military bureaucracy. This also became the model for the American private sector management.

Much of these reforms, though contributing to a more efficient Army and War Department, were also an instrument of social control. The Corps of Engineer Regulations became the model for the Baltimore and Ohio Railway rule book in 1828 (O'Connell, 1987: 100) although this has been challenged by Hoskin and Macve (1997).

The American system of manufacture - the West Point and the Springfield Armory connection

The revolution at the Springfield Federal Armory occurred under the superintendency of Roswell Lee from 1815 to 1833. Lee, a military officer, made Springfield "a credit to the government and an ornament to the nation" (Roe Smith, 1987: 54). Lee's major objective was uniformity.

However, unlike Springfield, Harper's Ferry Armory was under a civilian superintendent, James Stubblefield. Lee organised the Springfield Armory under two criteria, summed up by Chandler as follows:

- careful identification and inspection of each piece made via a worker's mark, approved by an inspector's counter mark placed on every piece approved;
- the meticulous double entry book-keeping for every transaction in the enterprise (Chandler, 1977: 73-74).

Lee also introduced innovations for worker control and discipline. These were not unique to Lee or the Springfield Armory but were similar to those innovations used in textile industries, in schools and in the penitentiaries.

However, unlike the latter institutions, the accounting method incorporated into the whole of the management structure of the Springfield Armory, including production, stock and labour control. In essence the structure was the incarnation of the power-knowledge concept and "the new power of writing" (Foucault, 1977: 185). This structure as manifest in the Springfield Armory under the superintendency of Roswell Lee, had been inherited from the earlier West Point Thayer reforms of 1819. Ordnance Department officers and former West Point graduates such as Daniel Tyler being the vehicle of the Thayer reforms into the Springfield Armory.

The Springfield Armory reforms were probably more advanced than other American public sector institutions, including board schools and penitentiaries because of the suspicion of the standing United States Army during the post-1814 era. Smith suggested that:

"Because every government agency stood accountable to Congress for funds received and expended, the department introduced sophisticated book-keeping methods at a very early date ... all officers in charge of federal arsenals and armories were required by regulations to submit quarterly returns detailing the work performed at their respective posts. Based on standard double-entry book-keeping these returns included abstracts and receipts of expenditures for buildings, raw materials and plant equipment, as well as detailed inventories of work performed and property on hand at the end of each period. The inventories identified and tabulated the types of arms manufactured or repaired and listed components still in progress and the amount of stock - coal, iron, oil and the like - remaining. In addition, the reporting officer transmitted monthly payroll accounts that recorded the name of each armorer, the type of work he performed, and the piece rate for each task, and his total wages. At the end of the fiscal year, the superintendent submitted an annual report that summarised the quarterly returns, tallied production and previewed plans for the coming year. After review by the chief of ordnance and his staff, these records were sent to the Treasury

Department for final auditing and approval." (1987: 57-58)

Unlike Springfield, Harper's Ferry Armory suffered "anti-disciplinary forces of the pre-modern culture". Here the master armourers ran their own shop. There were no work rules, absenteeism was rife and drink was available on the premises. For example, between 1816 and 1819:

"attempts to introduce work rules during the 1820s generally went unheeded. 'Workmen came and went at any hour they pleased', one officer recalled, 'the machinery being in operation whether there were 50 or 10 at work'. Along with these practices, armorers claimed the privileges of keeping frequent holidays, transferring jobs at will, drinking whiskey on the premises and selling their tools 'as a sort of a fee simple inheritance'." (Smith, 1987: 81)

The efforts of the US Ordnance Department to impress the need for uniformity on the superintendents of the Springfield and Harper's Ferry armories was not well received at Harper's Ferry. The craft-orientated armorers of Harper's Ferry "resented the intrusion of ordnance officers and often balked at their insistent demands for innovation and change" (Smith, 1987: 56). By the early 1840s the situation at Harper's Ferry had not improved.

In some way, this description of the Harper's Ferry Armory was similar to the workshop culture in the private sector British engineering industry during most of the nineteenth century. There is no evidence to suggest that either absenteeism or drinking on the premises was a problem within the British Ordnance Factories. However, part of the reason for the introduction of the eight-hour day in government departments in 1893 was to reschedule the day shift structure in order to eradicate the breakfast hour at the Royal Arsenal Woolwich. Some workers would frequent public houses during the breakfast hour, between 8.00 and 9.00 a.m. As a short-term measure Lee was seconded to Harper's Ferry. By 1841, however, the War Department decided

that the superintendents of all federal armories would come from the military. This is examined later.

Despite Lee's reforms, Hoskin and Macve (1988) argued that it still reflected a pre-modern system of production and control. The reforming zeal came later, which pushed Springfield into industrial capitalism. The man who influenced this was one of Theyer's West Point graduates, Daniel Tyler.

Tyler had come first in his class at West Point. Fluent in French, he was sent to the French Artillery School at Metz in 1828 and translated the French Artillery Manual for use in the US Army. Returning to America, Tyler was appointed to the Ordnance Corps in 1830 and given the newly created position of Chief Inspector of Contract Arms. From Tyler's influence, the Chief Ordnance Officer, Colonel Bamford (also a West Point graduate) could report to Congress in 1845 that the type 1841 model percussion rifle and the model 1842 percussion musket were interchangeable and could be made in large numbers anywhere, whether at the national armories or with private contractors.

Original French military textbooks were used at West Point (Hoskin and Macve, 1988). The US Ordnance Department and Corps of Engineers were closely modelled on the French Corps of Artillerists and Engineers. Many West Point graduates under Theyer's reforms were commissioned into the Ordnance Department or the Corps of Engineers. These Corps appeared to be the élite of the American military system and took the best of the cadets graduating from West Point. Thus many West Point graduates in the Ordnance Department or the Corps of Engineers eventually found positions in the federal armories or were seconded to the railroad companies.

The development of the Springfield Rifle-musket Mark 1 by mass production

In 1846, America was involved in a war with Mexico. This may have been the last major war which was fought with smoothbore muskets. From 1846 onwards, experiments were conducted to produce a standardised musket-rifle which had been developed into a Mark 1 production model by 1861. This was the Springfield rifle-musket, .58 calibre. The Mark 1 Springfield was designed to be produced by interchangeability and comprised of three component parts: (a) lock with percussion cap and hammer; (b) stock; and (c) barrel, which was rifled. The Springfield rifle-musket was a well-balanced weapon with a rifled barrel which fired a small conical-shaped bullet (the French modelled Minie bullet) smaller than the barrel. The bullet was hollow at the rear with two grooves. This fitted into the rifling of the barrel so that it spun on discharge from the breech. This extended the range and accuracy of the Springfield. The rifle-musket also had sights, a component absent from the smoothbore musket. One aimed a Springfield rifle but only pointed a smoothbore musket.

The development of the Mark 1 Springfield rifle coincided with the American Civil War of 1861-64. Until then, the Springfield Armory, despite its reforms, was a pre-industrial workshop. So too were the government manufacturing department workshops until the Crimean War of 1854-56. Both wars were fought on a 'modern' scale, where victory depended on high industrial logistical support. A railway network was established between Balaclava and Sevastapol. In both wars, but particularly the American Civil War, civilian targets were considered legitimate, causing many unnecessary casualties amongst non-combatants, a point previously mentioned in the introduction to this chapter.

The Springfield Federal Armory became the arsenal for the Union Army. Colonel Alexander Dyer was appointed as superintendent of the Springfield Armory. On appointment, Dyer industrialised the shift system by introducing two 10½-hour shifts instead of one. Production rates increased enormously as quantity exceeded quality.

The Federal Armory at Harper's Ferry Armory fell into confederate hands early on in the American Civil War, which resulted in the expansion of the workforce at the Springfield Armory. Cooper argues that "for the first time there was a scale of operation commensurate with Fitch's [earlier] assumption, that is [production] of over 100 gunstocks a day" (Cooper, 1991: 116). Prior to the Civil War the number of workers

"... engaged in gunstocking had shrunk from its pre-Blanchard tally of 35 to only 15 by July 1853, but had ballooned to 180 in 1864, a more than tenfold increase. But the Armory was producing sixteen times as many guns as in 1853, so the pre-worker productivity had gone up at a rough estimate from almost four a day in 1853 to over five gunstocks a day in 1864." (Cooper, 1991: 116)

However, despite the introduction of the 'American system of manufacture' in the Federal Armories, a craft-orientated mentality existed at Harper's Ferry well into the 1840s. Also, although both Armories employed interchangeability production methods, this did not eliminate all the craft-orientated tasks. Cooper suggests that:

"Over half of the gunstockers in 1853, and at least three-fifths of them in 1864 were doing handwork, so the machines, even in the second generation, had clearly not eliminated handworkers. But over the decades since 1820 the two generations of gunstocking machines, together with the division of labor and other kinds of production rationalisation has made possible this immense expansion of scale in a wartime emergency." (Cooper, 1991: 116)

Indeed, during the Civil War under the influence of Dyer, the Springfield Armory quickly adapted to reaching production demands needed in a modern war of

attrition. Prior to 1861, the Springfield Armory produced some 20,000 muskets a year, about 1,500 a month. During the peak of production at Springfield between 1863 and 1864 some 25,000 rifles were being produced per month. The supply of the Springfield rifle-musket to the Union Army was almost limitless. The range of the Springfield rifle-musket was longer and its accuracy and volley firepower over a longer range was more precise than the smoothbore muskets deployed by the Confederate Army. This deadly mismatch was seen at its most effective at the Battle of Gettysberg. In fact, the Springfield rifle-musket was a major factor in determining the outcome of the American Civil War.

The experiences of the Springfield Federal Armory under Colonel Dyer's command during the American Civil War transformed arms manufacture in America into a factory system. This was perhaps the nucleus for the notion of the Arsenal of Democracy which became apparent nearly a century later at Detroit during the Second World War.

However, mention has been made earlier in this thesis of the Portsmouth system of manufacture. This was pioneered by Samuel Bentham, Henry Maudsley and Marc Isambard Brunel who, in 1805, began the manufacture of ship pulleys and blocks through interchangeable production methods at Portsmouth Naval Dockyard. Samuel Bentham (1757-1831) was the brother of the utilitarian philosopher Jeremy Bentham (1748-1832), indeed Jeremy Bentham may have been influenced by the concept of panoptican philosophy from his brother Samuel. This concept became the cornerstone within the philosophy of the *laissez-faire* economic liberalism of the nineteenth century. In its practical application, the panoptican concept related to penal and workhouse architecture and to factory design. In terms of interchangeability and

production, the panoptican ideology related well to the deskilling of labour (Braverman, 1998: 110). Even the transformation of the accounting systems, including those at the Ordnance Factories, may have been influenced by the panoptican ideology. According to Hoskin and Macve, this was also apparent in Thayer's reforms of West Point Military Academy from 1819 where "it was specifically a grammatocentric form of panopticism, whose modus operandi was constant writing, grading and examination" (1994: 82). Again in terms of accounting functions and systems, Hoskin and Macve suggest that accounting:

"... has become one particularly privileged way of measuring and restructuring man as the 'calculable person' ... it has also come to play a strategic role in the development of a new, grammatocentric kind of 'managing by the numbers', exemplified in the emergence of what Alfred Chandler (1977) has called the 'modern business enterprise'."

From 1780 to 1791 visited Russia where he was employed on Prince Potemkin's vast estates near Smolensk. Here, Bentham devised woodworking machinery including a planing machine which was sufficiently easy to operate that it could be used by unskilled peasants. In 1787, Bentham designed circular buildings in which to install and operate his woodcutting and planing machinery. These buildings were designed as a panoptical model with the supervisor's office located at the core of the building, directly overlooking the work in progress (Cooper, 1984: 193). This design is very similar to Jeremy Bentham's design for a panoptican penitentiary in London, which became manifest at Pentonville Prison as the new model penitentiary from 1835 (Pentonville Prison is still an operational establishment). The establishment of a panoptican concept as it permeated into the emerging factory system, including the Ordnance Factories, with overseers, inspection, time measurement and payment by results, ultimately led to a management system which could be measured with

notionally similar applications to science. Thus emerged the creation of what became known as scientific management (Braverman, 1998: 59).

The influence of Samuel Bentham's experiences in Russia was noticeable in the Portsmouth production line which, when installed:

"was capable of producing about 700 small blocks, 570 medium blocks or about 240 large blocks, or a total of about 1,420 daily. Taken together the three sets of machines were versatile enough to make thick-sheaved blocks of about seventy-two standard sizes ... thin sheaved blocks in forty-eight sizes plus ... up to more than 200 'sorts and sizes' in all." (Cooper, 1984: 206)

The Portsmouth system of manufacture, however, from its inception in 1805, remained for the most part an intellectual curiosity until the arrival of the Great Exhibition.

The Molesworth Committee and the Board of Ordnance Commission's visitation to the US federal and private armories

The Great Exhibition of 1851 revealed exhibits of American produced small arms with interchangeable parts. The Board of Ordnance was faced with the poor technological state of British arms manufacture and the chaotic state of the Birmingham gun trade, which supplied much of the Army's requirements in small arms. Thus a Parliamentary Commission headed by Joseph Whitworth went to America to examine the federal and private armories which manufactured these high technological small arms.

This was the nucleus of the Parliamentary Select Committee on the manufacture of small arms established in 1854. The Committee, according to Behagg, "focused upon the archaic nature of the Birmingham gun trade. By comparison with its American cousin it was apparently hidebound by craft practices and under-capitalised as a result" (1998: 3).

The Select Committee chaired by Sir William Molesworth initially authorised officials of the Board of Ordnance to inspect private sector institutions. For example, the War Office Register of Letters no.1568 of Saturday 26 February 1853 records that:

"The Inspector of Artillery authorised to direct Mr. Anderson and Lieutenant Warlow (RA) to visit certain manufactories in the North of England, for the attention of Mr. Payne". (WO 47/2746)

Later, on 7 October 1853, the Inspector of Machinery at the Royal Arsenal, Mr. John Anderson, was sent to the original Royal Small Arms establishment at Enfield, in order to inspect the manufacture of bayonets by machinery. Anderson duly reported to the Board of Ordnance and recommended the erection of a further government factory on the same site as the existing Royal Arsenal which, once production was commenced, would deliver 500 muskets a day. Anderson recommended the Woolwich site as there was already a reserve of skilled labour within the surrounding area.

However, there was considerable opposition to Anderson's recommendation of a proposed new small arms factory within the Arsenal site at Woolwich. The government of the day set up a parliamentary select committee under the chair of Sir William Molesworth to examine Anderson's report and recommendations, the terms of reference being to enquire of "the cheapest, most expeditious and most efficient manner of providing small arms for Her Majesty's Government" (Hogg, 1963, vol.II, Appendix IV, p.1073).

There were fourteen members on the Molesworth Committee including James Monsell, clerk to the Board of Ordnance, who acted as secretary to the Committee. Monsell himself chaired two later select committees into the government manufacturing departments during the early 1860s.

Witnesses giving evidence to the Molesworth Committee included private arms manufacturers, in particular Naysmith and Whitworth, and Colonel Samuel Colt of the American Pistol Factory. Anderson, who was at this time chief inspector of machinery at the Royal Arsenal, also gave evidence to the Molesworth Committee. Molesworth's eventual report consisted of some 570 pages, in two volumes.

The normal method of small arms manufacture for muskets in bulk for use by the Army, the Admiralty and the Honourable East India Company, was to purchase by open contract all the separate components of the weapon. After passing a quality examination, the component parts were then placed into store. Issues were then made both to the factory at Enfield Lock and, to a greater degree, to private contractors. Both the government factory at Enfield Lock and the private contractors were no more than assembly lines of component parts. The assembled and finished weapon was finally inspected by a government inspector and either accepted or rejected. The rejection rate was high, due to the varying methods of production processes from the contracting firms. There were also differing practices of assembly and working arrangements at the government factories at Enfield and Birmingham. Thus the high rejection rate was due to inefficient production and assembly processes. By 1855 this was causing a major concern to both the Army and to Parliament. Britain was engaged in the Crimean War, which reflected the inefficiencies of small arms performance under field conditions. The government of the day was also under considerable pressure to economise on the expenditure of public monies from a vexed Victorian taxpayer. Evidence from a senior inspector's report on the increasing rejection rate of musket barrels was presented to the 1854 Select Committee on Small Arms:

"Another and very potent element of difference arises out of the system under which the manufacture is carried out at two places (i.e. Enfield

and Birmingham). *At Enfield* no workman is admitted unless he be of first class in his trade, and of sober, moral and regular habits. He has the assistance of the best machinery and works under the immediate eye of the viewer, who corrects any error of work as they arise. He has a comfortable home and receives his wages in full at a certain hour every week.

Whereas *at Birmingham* the first and ruling question is price; the man who will work at the lowest rate is entrusted with it, without much care as to capability or character, there is little or no tie between him and his master; he is mulcted for the millpower that he uses and for tools, and he receives his wages often very irregularly. The consequence is, that his workmanship is inferior, and the men resort to all sorts of shifts and tricks to evade the viewer's eye. The master complains of the injustice of the inspection, when it is his own fault for employing inferior workmen and screwing them down in price." (quoted by Hogg, vol.II, Appendix IV, p.1074)

The government factory at Birmingham reflected the contemporary small craft Birmingham gun trade generally. The system was accepted by mid-Victorian society as it equated to Victorian capitalism generally of small family structure and the consumer preference for craft-produced artefacts, as previously described by Payne (1967). The Birmingham gun trade produced utilitarian small arms, mainly for the military, whereas the London gun trade supplied more aesthetic small arms which were individually made for the sporting and field market.

There is evidence to suggest that the Birmingham gun trade generally was affected by a small workshop mentality, restrictive practices and by the craft myth. These are themes which will be returned to later. One engineering witness in evidence to the Molesworth Committee asked: "Why are the manufacturers of Birmingham so much at the mercy of their men; if they have the quality of machinery that I think is acceptable to gun making they ought to be quite independent of those men and not knuckling down to them as they are" (report from the Select Committee on the Manufacture of Small Arms, PP 1854, xviii, 12, cf. 1662; Behagg, 1998: 3).

Colonel Chalmer and Lt Col Tulloch in a statement to the Molesworth Committee reviewed the existing state of small arms manufacture in the UK. Both officers demonstrated the impossibility of exercising proper governmental control as to price and quality. Their report painted a picture almost from the contemporary *Hard Times* by Dickens, of underpaid men working with ill-equipped machinery in wretched garrets and dark cellars, under which conditions standards of workmanship and accuracy were bound to suffer. Both Chalmer and Tulloch argued for reform with an up to date government factory sufficiently large to cope with the quality and quantity of arms required.

At the commencement of the Napoleonic War in 1802, the scarcity of arms was so great and the need for arms so urgent that the government had recourse to foreign markets and bought up all the weapons that could be obtained. These were poor in quality, heavy in pattern and cumbersome. Only a relatively few were obtained.

During the immediate post-1815 period, the manufacture of small arms for the government ceased and many workers deployed at Enfield were laid off. Only a small nucleus remained at Enfield to manufacture small arms ammunition for a much reduced Army and Navy.

By 1840 an attempt was made to produce weapons sufficient in quality and numbers to equip the Army. Great difficulties were experienced in obtaining the requisite skilled labour force. This state of affairs was still apparent at the outset of the Crimean War.

So, on 12 May 1854, the Molesworth Committee recommended that the existing system of contracting for the supply of small arms should be discontinued.

It considered, however, that the Board of Ordnance should undertake the manufacture to a limited extent. This amounted to the production of small arms at a government factory to supply two thirds of the total demand. Such a factory would serve as an experimental plant whereby the advantages of government manufacture could be observed. The new factory would be a laboratory for all arms manufacture in Britain. Also, a government small arms factory would act as a check upon contractors' prices as well as a nucleus for any increase in times of national emergency.

However, the Board of Ordnance were a little apprehensive of Molesworth's recommendations. In 1855, despite the ongoing war with Russia, there were delays in production of small arms from the private contractors. Strikes were common in the private armories, both in London and Birmingham. There were also allegations of profiteering. The Board of Ordnance, in an attempt to circumvent industrial action in the private sector, took control of all small arms manufacture until the cessation of hostilities. The Enfield factory was expanded to meet the increased demand and the government of the day increased the factory's budget to £150,000 to cover the costs of additional resources.

Prior to the Board of Ordnance Commission visit to the American federal and private armories, John Anderson, Captain Dixon (Royal Artillery) and Mr. James Gunner (Chief Inspector of Small Arms at Enfield) were granted permission to visit manufacturers at Manchester and Leeds to inspect machinery for the manufacture of bayonets and locks for muskets (WO 42/2752, no.861, 13 March 1855).

On the advice of Mr. (later Sir) Joseph Whitworth, a mission consisting of Lt Col Burn, Major Tubeville and Captain Warlow, all of the Royal Artillery, Messrs. Anderson and Whitworth were sent to the United States to collect information about

small arms manufacture, from the American federal and private armories. Captain Warlow was also empowered by the government to purchase machinery in America, in particular for instruments "for taking the specific gravity of metals and some hand tools for the manufacture of metal tubes" (WO 42/2752 p.455, 5 February 1855). Cooper comments that "the Blanchard's lathe was especially prized among the British for their new Armory at Enfield" (Cooper, 1991: 120).

The National Armory at Springfield played a major role in the initiation and co-ordination of interchangeable parts. Springfield attempted to co-ordinate its operations with those at the National Armory at Harper's Ferry. However, the US Ordnance Department also contracted with private armories. Through this contracting system and by specifying interchangeability within the tenders of contract awarded to private armories, this gave access of technological knowledge as used in the national armories to the private arms manufacturers. In particular, the US Ordnance Department contributed significantly to the growing sophistication of metalworking and woodworking in the United States by the 1850s (Hounshell, 1984: 62).

The Board of Ordnance visit to the United States had gone to discover everything about small arms production and the Commission were also authorised to purchase American arms making machinery, beginning with Warlow's remit, as already stated, but which increased as the fact-finding mission began to be more suitably impressed.

Hounshell (1984: 62) argues, however, that Anderson in particular was not necessarily aware that unit costs at the Springfield Armory with interchangeable parts in small arms manufacture was larger than those small arms produced under more traditional methods. However, Anderson was probably aware that the US Ordnance

Department could produce annually only a relatively small number of Springfield rifles, manufactured with interchangeable parts. Perhaps Springfield and interchangeability leading to low unit costs came about during the American Civil War, with maximum output, a point discussed previously.

Despite the apparently high costs and limited output, Anderson remained optimistic. Through his observations of the American armories, Anderson suggested that the process of interchangeability could be adopted almost universally within British metal and woodworking establishments.

Hounshell states that "the idea of interchangeable firearms captivated the British Board of Ordnance and many members of the select committee much in the same way it had the United States Ordnance Department in the 1800s" (1984: 62). Hounshell also stated that Anderson, in:

"learning the whole of the American system at Springfield, was aware of the fundamental importance of 'hundreds of valuable instruments (jigs and fixtures)' and gauges that are employed in testing the work through all its stages, from the raw material to the finished gun."
(Hounshell, 1984: 62)

However, Anderson was aware that "American manufacturers would become exporters to England... [This] came to pass in the second half of the nineteenth century" (Hounshell, 1984: 62).

The concept of interchangeability involves a quite different production process from that apparent with British arms manufacturers. Indeed, the principal contract arms manufacturers for the Army were mainly located in London and Birmingham. Although there were significant variations between one contractor and another, the production process was undertaken in a workshop rather than a factory environment, with skilled craft labour. This traditional process was very decentralised and reflected

the use of agents as middle-men, sub-contracting and employed craft labour, with the attendant restrictive practices and demarcations. Cole suggested that:

"In most branches of the British engineering and kindred industries, ... the position ... is essentially different. Piecework and other forms of payment by results have not been introduced into these industries. Moreover, there is not, in the great mass of British engineering operations, any standardisation at all approaching that which exists in the textile industries. The work done is still largely of a jobbing character, or, even if processes are repeated, for skilled men at least the 'runs' are, as a rule, comparatively short. Consequently, new piecework prices and basis times have constantly to be arranged for fresh operations, while the fact that the machinery also is by no means standardised means that the price for the job has not infrequently to be modified in accordance with the character and equipment of the machine-tool on which it is to be done." (Cole, 1922: 13)

However, the craft orientated nature of British engineering and allied industries may only be reflecting local consumer demand. Payne, in a comparison between the emergence of the large-scale company in Great Britain between 1870 and 1914, suggested that the British preference for craft orientated products "of British consumers for articles exhibiting 'craftsmanship' and individual character" was one of the major causes of restrictions to diversify and enlarge (Payne, 1967: 524) but the contemporary American national market reflected an opposite character, where there was a "willingness to accept a mass-produced standardised product" (Payne, 1967: 524). This is a major reason why interchangeability was an attractive method to be employed in America rather than Britain. Interchangeability as observed by the Board of Ordnance Commission to the American armories reflected a production system evolving into a factory system which reflects decrafting of labour and labour flexibility. The complete factory system occurred during the American Civil War six years later.

The Board of Ordnance and in turn the Select Committee had obtained most of their information on the American arms manufacturing technology from Colt and

from Joseph Whitworth, a noted Manchester machine tool manufacturer. Whitworth had toured many American arms factories and the federal armories whilst serving as a commissioner to the New York Crystal Palace Exhibition. His 'Special Report' on American manufacturers proved to be of major interest to the British. Another commissioner, George Wallis, had also seen the Springfield Armory and had written a report on his US tour. He too served as an informant to the Board of Ordnance. Colt, Whitworth and Wallis were among the experts called to testify before the committee. Other witnesses included:

- The machine tool maker James Naysmith.
- A former superintendent at Colt's factory, Gage Stickney.
- A noted English machine-builder, Richard Prosser.
- The Board's own technical expert, John Anderson, who was inspector of machinery at the Royal Arsenal.

Anderson was the author of the Board's proposal to establish a small arms plant. After a four-month study trip to the USA he was the most ardent advocate of American small arms production technology. Anderson was perhaps the most knowledgeable British engineer on the subject. The testimonies of all these men, however, suggest the ambiguities of the system adopted in the US armories to produce muskets.

For the purpose of analysis, the committee's investigations can be classified into five categories of questioning:

1. Whether small arms could be produced by machine.
2. Whether mechanics and machine tool builders could produce a weapon.
3. What effect mechanised production would have.
4. Whether arms made by machine would contain interchangeable parts. A

corollary question was what was meant by 'interchangeable'!

5. Whether the Americans had indeed pioneered this approach to production.

The Ordnance Factories however were a microcosm of the American system of manufacture. The process of a factory manufacturing system and interchangeability created management progression and reform to include costing, DEB and systems similar to scientific management. This was also influenced by the prevailing *laissez-faire* economic doctrine of the day. Nevertheless, the Ordnance Factories had to compete with the corresponding private sector. In the production of small arms and of military and naval guns, the Ordnance Factories were supreme.

The private sector in Britain and its attitude to interchangeability in production - the Birmingham gun trade

The Portsmouth system of manufacture (Cooper, 1984) did not spread in Britain despite its success, indeed the system was regarded merely as a novelty within British contemporary society. Cooper commented on the "propensity of the British working men to be suspicious rather than enthusiastic about labour-saving inventions compared to their American counterparts" (Cooper, 1984: 222). She also considered that the British class system was a factor:

"by restricting workers' opportunities in job mobility, education and promotion, made them view themselves more often than did workers in the 'American system' as potential victims rather than participants in the process of mechanisation. The class system thereby acted through the social psychology of workers as a drag on attempts to rationalise manufacturing methods." (Cooper, 1984: 222)

Writing in 1927, Allen gives a cursory account of the Board of Ordnance visitation to the Springfield Armory in 1853 and of the decision by the War Office to build an establishment at Enfield "where guns might be made on the interchangeable

principle" (1927: 187). He suggests that there was not only opposition from the gun trade but also from the "active exponents of *laissez-faire* [who were] aroused by this proposal" (1927: 187).

The civilian gun trade in Britain was a niche market "with a privileged clientele who expected a custom-made gun for the sport shooting" (Cooper, 1984: 223). Cooper suggested that the ordering of a sporting gun in Britain by the upper classes was more akin to ordering a tailor-made suit. The gun was tailor-made to fit the owner; the gunsmith as well as the tailor had careful measurement entries of their clients made in their books (Cooper, 1984: 223).

Cooper argued, however, that the consumer preference in Britain for custom-made and locally manufactured goods discouraged production-line methods of manufacture. This argument is also relevant when comparing the structure of business organisations in Britain compared to America during the nineteenth century (Payne, 1967; Chandler, 1996), despite the success of the Portsmouth system from 1805. Cooper commented that:

"A market that was biased towards the upper class militated against mass production of clothing even after the coming of the sewing machine in the 1850s made it possible. In a related endeavor, the ever-inventive and ever-optimistic Brunel met disappointment after he went into business in 1812 to supply mass-produced footwear for the British Army. He had invented a series of machines for making shoes and boots, employed crippled war veterans to man the machines, and began producing 400 pairs daily. When the war ended sooner than expected in 1815, he was left with a large stock of unwanted shoes. That was one of the financial blows that eventually put him into a debtor's prison in 1821... The shift from hand to machine industry in the British shoe trade took place ninety years later. Similarly, there was insufficient demand for standardised carriages in a country that later produced customised Rolls Royces rather than Model T Fords." (Cooper, 1984: 224)

The reaction by the Birmingham gun makers was to form an association known

as the Birmingham Small Arms Trade. On its formation, the association consisted of sixteen firms, originally selected by the Board of Ordnance to supply small arms at the outbreak of the Crimean War. The Association agreed to fix the wages of their workers and to "determine selling prices" (Allen, 1927: 188).

In 1861 the Association organised itself into a company and erected a factory at Small Heath, Birmingham. According to Allen, the factory was equipped with machinery capable of producing interchangeable arms comparable to those at Enfield. "Stocking machinery was purchased from Massachusetts and rifling and boring machinery from Leeds, and the famous Birmingham Small Arms Company Limited was set upon its long career" (Allen, 1927: 188). Allen stressed that "it cannot be too strongly emphasised that the Birmingham Small Arms Company was the first of the local factories to turn out highly finished complicated metal articles by mass production methods" (Allen, 1929: 191).

The creation of the Birmingham Small Arms Company (BSA) was due to the establishment of the Royal Small Arms Factory at Enfield in 1857. Initially, in 1862, BSA received a large War Office contract when the Army adopted the Snider breech action rifle which could interchange with the standard Army issue Enfield rifle musket. BSA were contracted to convert 100,000 Enfield rifle muskets to the Snider breech mechanism. The Army decided to convert all its holdings of Enfield muskets to the Snider breech mechanism. Also BSA obtained a considerable amount of trade as a consequence of the American Civil War and also produced 50,000 Enfield rifle muskets for the Turkish Government. The War Office contract was the largest Army order BSA received until the second Anglo-Boer War in 1899.

However, the experiences of the Birmingham Small Arms Company (BSA)

were unique to the Birmingham gun trade generally. Allen did not refer to the two Enfield satellite rifle factories located at Sparkbrook and Bagot Street, Birmingham in his work.

Despite this, it may have been the influence of the Army Contracts Department which slowly began to encourage private arms manufacturers to reorganise their production methods on interchangeability methods, and form what was to become BSA in order to successfully tender for Army contracts. The Director of Army Contracts, Evan Nepean, stated in his annual report of 1882:

"The Birmingham Small Arms Company is, or was, an amalgamation of the old firms that in former days made parts of muskets and rifles for us and for the East India Company.

The company first turned out non-interchangeable arms and subsequently at the instigation of the [Army Contracts] Department, set up special machines for the production of the interchangeable rifle. Further alterations of machinery have been necessitated by the conversion of muzzle-loaders to Sniders, the manufacture of new Sniders and two patterns of Martini-Henry rifles.

Taking the period of duration of an interchangeable rifle at 20 years, the calculated annual want to replace wear and tear could not reach 3,000 arms.

In a report on this question written in 1878 I showed that the trade had no orders for small arms from us from 1817 to 1842, and only then because a fire at the Tower of London quickened the introduction of a new pattern, Brown Bess.

The trade is only useful when a new pattern is to be made, at other times it is a source of expense to us and reaps no profit for itself." (Annual Report of the Director of Army Contracts for 1882, p.27, WO/395/1)

There is evidence to suggest that despite the introduction of interchangeability at BSA, the company still subcontracted for component parts. Also, the company still had problems in getting craft workers to adjust to the new methods of production. A description of the operations in BSA in 1910 clearly suggests that at least some of

the firm's workshops were dominated by the handicraft methods: "... workshops formerly occupied by benches and vices, are now almost exclusively filled with machinery" (*Proceedings of the Institution of Mechanical Engineers*, 1919, parts 3-4, 1324).

In 1862 before the BSA had acquired its stocking machinery, it was observed that "at present the gunmakers of Birmingham had to pay a high price to have their gunstocks made by machinery in London, in order to secure greater accuracy and finish of workmanship than was obtained in handwork". Such machinery then existed at Enfield "and ... nearly a similar set at the London Armoury Company's works in London" (Thomas Greenwood, 'On machinery for the manufacture of gunstocks'). The firm eventually acquired a complete set of stocking machinery from the Ames Manufacturing Company (*The Engineer*, XVI, 25 December 1863, 375).

More generally, the specialised American machine tools which were so closely associated with interchangeable manufacture achieved only a very gradual acceptance in Britain in the private sector generally. In 1867 Anderson deplored the failure of British industry to adopt the milling machine, which was not in fact widely adopted in England until the bicycle craze of the 1890s (Saul, 1969). The reason for this failure by British industry to utilise new technology was due to the ossification of British capital structure and the home market preference for craft-orientated goods, as explained by Payne (1967). This was previously referred to in Chapter 1.

The British experience with the turret lathe, which began to be widely used in the USA during the 1850s and 1860s, was also one of slow and grudging acceptance. Moreover, even where it was adopted, principles of machine design which were taken for granted in the USA were often stoutly resisted. The turret lathe does not

seem to have been exhibited at the London Exhibition in 1862. As late as 1902, an eminent British engineer found it necessary to reprimand British manufacturers for using turret lathes which did not incorporate interchangeability in their construction, a feature which was embodied in American turret lathes in the 1850s.

However slow the introduction of the new techniques may have been, and whatever the reasons for the slowness, it is clear that their introduction into British industry was directly linked to the importation of American firearms machinery into the Enfield Rifle Factory in 1855. Allen makes this point forcefully with respect to the Birmingham area and the experience of BSA and the process of interchangeability:

"This meant that certain kinds of complex machinery began to appear for the first time in large quantities in a Birmingham factory, while new methods came into existence for the production of standardised parts. For instance it now paid to sink dies and stamp out rifle parts which previously had been forged by the smith on an anvil. Thus the coming of interchangeability in rifle manufacture brought not only the machine shop and tool room in their modern forms, but also the method of hot stamping. This process, previously confined to such products as keys and edge tools, now began to play a much more important part in Birmingham's manufacturing operations." (Allen, 1929: 191)

There was also a reluctance for the old craft gunsmith to adapt to the new methods of production through interchangeable parts at BSA.

"A number of Darlaston lock and spring filers were engaged by the Birmingham Small Arms Company, and a struggle immediately took place between them and their foreman, who tried with little success to induce them to give up old time methods and prejudices. These men still followed the practice of a hundred years previously ... they still resorted to fiddle-drilling (i.e. bow and breast drilling) when, by going a few yards, they could use power machinery. They still used tallow-dip candles (purchased by themselves) when tempering springs, though the company had offered to supply them with best Russian tallow free." (Allen, 1929: 189)

In contrast, the American private small arms market began to manufacture under the process of interchangeability. Cooper argues that:

"The Whitney Armory, for example, which had started on a government contract was able to advertise cheap and standardised guns in a brand new civilian market... But even after the Enfield Armory began to use the American system of manufactures for making military small arms, English manufacturers of lightweight sporting guns continued (and continued well into the twentieth century to use their old methods of production)." (Cooper, 1984: 227)

The distinguishing features of the Birmingham gun trade, excluding BSA, were as follows.

- 1. Smallness of scale.**
- 2. Dependence on skilled craftsmen.**
- 3. An extensive division of labour in the production of components and their eventual 'setting up'.**
- 4. Localisation - most of the Birmingham gun trade was located around the district around St. Mary's Church.**

These characteristics applied not only to guns but to a considerable extent to most of the trades producing finished goods in Birmingham, including the jewellery and other retail trades and to the engineering / metal industry in Britain at the time. Allen observes that:

"There has been no 'industrial revolution' in Birmingham and District. Its great economic development was marked by a vast increase in the number of producing units rather than by a growth in the size of the existing few, and the factory still remained unrepresentative of the majority of the concerns producing finished goods." (Allen, 1929: 46)

Of Birmingham itself, it was said in 1856 that nothing was on a large scale and that the manufacturing class had not raised itself to any large degree. The concentration of capital and the development of large-scale enterprises had not taken place there, as in the northern centres of industry, and most master manufacturers, it was declared, employed only five or six workers. This was equally true of the Black Country's

small metal industries (Allen, 1929: 113).

At the time of the Crystal Palace Exhibition the gun trade was still the province of the skilled craftsman. Mechanical assistance was virtually non-existent except for a few instances such as the rolling, boring and grinding of barrels or the rolling, grinding and polishing of bayonets and rammers.

A so-called master gunmaker typically possessed neither factory nor workshop. Often, he possessed a warehouse and arranged to acquire components from specialised craftsmen who may have worked from home or in more sizeable workshop establishments. The co-ordination of these separate activities in a manner which assured continuity of operation was a formidable task and, as might be expected, led to interruptions whenever the supply of a particular component was disrupted.

However, the War Office did assist the Birmingham gun trade, including BSA, in time of recession. During the 1880s the Birmingham gun trade was facing a depressed market. An extract from the Annual Report of the Director of Army Contracts for 1882 stated the following:

"The military small arms company in Birmingham after a long struggle to keep alive in the absence of orders, are going into liquidation."
(Annual Report, 1882: 27; WO/391/1)

The following year (1883) the Director of Army Contracts was directed to place orders for 3,900 rifles with the Birmingham 'trade' which would otherwise have gone to Enfield (Annual Report, 1883: 17; WO/391/1). But the Director of Army Contracts, no doubt on the advice of his political masters, would divert orders from the Ordnance Factories and place them under contract when the private sector was facing recession.

Most English manufacturers did not wish to adopt the American practice that Anderson, Colt, Naysmith and others had declared to be universally acceptable. But

neither did all manufacturers in the United States. Indeed, when Anderson toured Derringer's pistol factory in Philadelphia, he was "astonished" to find that traditional hand methods were still in use (Rosenberg (ed), 1969: 193; Hounshell, 1984: 64). However, this was also true of English pistol manufacturers. In his Annual Report for 1887, the Director of Army Contracts reported that:

"There are but few pistol makers on the interchangeability principle in England. Mr. Kynoch MP owns Trantor's Factory Birmingham, but is unable to compete, being in Parliament, and Mr. Locke of Adams (London) Workshop does not turn out good work. Practically Webley of Birmingham has all the first class private trade." (Annual Report, 1887: 15, WO/395/1)²

The last decade of the nineteenth century witnessed acrimonious labour disputes in the private engineering industry, particularly on the issue of the eight-hour day. With the formation of the Engineering Employers' Federation, the disputes became even more gridlocked as the Federation and the Amalgamated Society of Engineers were loggerheaded into a strike and lockout for seven months in 1898. Much of this dispute was more than the argument for an eight-hour day, it was more to do with the Employers' Federation's attempt to introduce interchangeability and decraft workshop skills, ritual and demarcation through piece working. Previously, in 1894 an eight-hour day had been introduced into the Ordnance Factories. This topic is explored later in Chapter 7.

² George Kynoch 1834-1891 (DBB) vols 2-3 pp.630-2. Described as an ammunition manufacturer. No reference is given in DBB that Kynoch produced small arms. *The Times* obituary notice describes Kynoch as a gun manufacturer (2 March 1891). Conservative Unionist MP for Aston, Birmingham. Owned the Whitton ammunition factory in Birmingham, the second largest of its day, employing some 800 people with the capacity to produce 400,000 cartridges. Kynoch was no supporter of the divorce of ownership from control being dismissed after the flotation of his organisation.

‘Armory practice’: the dissemination of mass production into the private sector - the American and British experience

The transition of the Springfield Armory into a factory system probably occurred during the American Civil War (1861-64). However, the Board of Ordnance Commission to America was influential in the establishment of the Enfield Rifle Factory on a factory system and production under the process of interchangeability. The fundamental difference between the American experience and the British experience can be seen in the transition of interchangeability into the private sector. This developed into the manufacture of a variety of civilian artefacts ranging from sewing machines, McCormick reapers, bicycles and eventually automobiles. A commentator writing in 1890 noted that: "Intelligence of what was transpiring at the [Springfield] Armory is widely diffused... The news reached and enchanted the sewing machine men ..." ('The American System of Manufacture', *American Machinist*, 1890, quoted by Hounshell, 1984: 67). Indeed, the onset of interchangeability later in the American automobile industry was known as armory practice.

The transition of interchangeability and factory production in the engineering / metal industry in America resulted in the subsequent developments particularly in costing and scientific management practices. In America up to 1914 there were major developments of cost accounting. The contemporary British economic situation was not so developed. The majority of the privatised engineering industry reflected a craft-orientated workshop mentality. The apostles of scientific management from America "had long claimed that modern engineering production could dispense with craftsmanship: 'their essential principle was that the machine man should not exercise any discretion at all'" (Hinton, 1973: 98, quoting from *The Engineer*, 1903).

By contrast, in America it was agreed "by competent observers in this country and in Europe that America's increasing prosperity and high standards of living are due chiefly to the rapidly increasing use of scientific mass production and distribution" (Edward A. Filene, quoted by Hounshell, 1984: 303).

Yet these influences and the introduction of cost accounting and scientific management in the United States before 1914 only began to have a major and permanent impact on British industry after 1945. By comparison, in the United States during the latter half of the nineteenth century there is evidence that cost accounting was being used on a large scale to promote business efficiency. For example, when Andrew Carnegie took over control of the Edgar Thomson Steelworks in Pittsburg, he appointed William Shinn from the Pennsylvania Railroad Company as his Chief Executive. Shinn implemented costing systems which acted as a decision-making tool for Carnegie.

This trend continued in the United States. Pierre du Pont, a graduate in management studies from the MIT, was employed by the E.I. du Pont de Numours Powder Company. Pierre du Pont and his colleagues placed a definition on costs, which ended "the long separation between cost, capital and financial accounting" (Chandler, 1977: 445-7). This may have been true for the United States, however, but it was not until post-1945 that du Pont's definition had any relevance in British industrial management.

After carefully defining costs, du Pont with his management team devised a more precise definition of profit together with a more specific criterion for evaluating performance. Indeed, du Pont and his team actually combined and consolidated the three basic but otherwise separate types of accounting and thereby laid the foundation

for modern asset accounting. This was achieved by 1910.

However, there were many sceptics who felt that large organisations like du Pont would collapse through internal inefficiency or alternatively would pass on the costs of their bureaucracies to the consumer, thus resulting in bankruptcy through lack of competitiveness. But du Pont and his modern asset accounting structures actually lowered the cost of integrating each departmental activity. The system allowed for routine data of daily operating decisions and long-term information about the return of investments. The techniques pioneered by du Pont were quickly incorporated into American industrial management and developed by the largest entrepreneurial structures in the United States, principally by du Pont, General Electric and General Motors.

The elements of cost accounting within the British economy in 1914 were not so sophisticated. A Board of Trade investigation, begun in 1916, reported:

"Of course all efficient firms in this country have proper systems of costing. We think, however, that the essential value of a careful system of costing to ensure the maximum economy has not yet received from many houses the attention it deserves. Certain large works are known to have no system of costing at all. Other works are known to have a system of costing based upon conventional rates of wages in those works some years before. It may be assumed that most small works have only a costing system more or less reduced to a rule of thumb." (Board of Trade, *The Position of the Engineering Trades after the War*, Cd 9073, 1918: 11; Loft, 1986: 141)

The differences between the American and British cost accounting experiences can also be seen from the following article written in 1923.

"In America the cost accountant has come much more quickly into his own than with us, and for obvious reason. America is the home of mass production ... it takes naturally to mechanical records. It has been comparatively untrammelled by trade union regulation, money making is a clearer objective in itself than with us... In America, therefore, there is a ground not only favourable, but thirsting for cost accountants. There is a business public keenly alive to his use. He is

one of the luminaries of the economic world. (*The Cost Accountant*, 23 March 1923: 332; Loft, 1986: 142)

A Miles Taylor, a chartered accountant with working experience in America, who advertised himself as a Chartered Accountant and Efficiency Engineer, was censured by the ICAEW who considered that this was "discreditable to Chartered Accountancy" (*The Accountant*, 28 June 1919: 552; Loft, 1994: 119).³

Conclusion

This chapter has sought to explain the sources of interchangeability and its full-scale emergence within the American Federal Armories. The concept of interchangeability requires the manufacture of a standardised product in long runs through a management / control process of scientific management, quality control and costings. Its successful introduction both in America and Britain within government arsenals also reflects the lower costs of production process together with quality in this form of mass production. The Treasury was content, as was the taxpayer both in America and Britain.

³ The actual comment by Taylor appeared in *The Accountant* as a matter of humour rather than of a serious nature. Taylor stated that on his return from the United States in 1914 "with more enthusiasm than common sense", he had put up the plate describing himself both as a chartered accountant and efficiency engineer. Taylor, in reiterating the Institute's reaction, was met with laughter from the audience attending a conference on scientific costing where the main speaker was J.M. Fells FSAA (*The Accountant*, 28 June 1919: 552). Taylor was appointed to the Committee of the Institute along with Lieutenant Colonel J. Grimwood DSO and J.M. Fells. Taylor, a British accountant, had spent several years in the United States prior to 1919 where he had experienced scientific management principles. Later in 1919 he was critical of the lack of knowledge of costing techniques by British accountants employed within the Ministry of Munitions (see later in this thesis). In 1921 Taylor wrote a book called *Business Organisation and Management*, published by Pitman. The success of Taylor's book was limited, however and it was not a great success. By 1925, Taylor was the Principal of the British College of Accountancy, Coleman Street, London. The College taught traditional accountancy for the ICAEW and for the Scottish equivalent (*The Balance*, vol.11, no.6, Spring 1925, 48A).

Small arms produced through interchangeability were more efficient in terms of the job they were designed to perform and this was evident from the Union Army in the American Civil War. Repairs and replacements could easily be undertaken without any major logistical backlog.

The introduction of interchangeability and the establishment of the Royal Small Arms Factory and the Royal Gun Factory quickly changed the production process into one of a factory system which deployed the concepts of (a) costings and DEB and (b) scientific management within a short period of time. Such reforms did not make any great inroad into the British private engineering industry until well into the twentieth century. This is despite the initial euphoria within the post-1918 period. Wilson, reflecting on the post-1918 era, refers to the fact that:

"Membership of the Works Management Association ... totalled around 900 by 1929, but there were approximately 250,000 works managers in the country at that time. Similarly the Institute of Industrial Management, formed in 1920 as a key vehicle for spreading the gospel of Rationalisation, was by the end of the decade almost moribund." (1995: 156)

However, the fact that the Ordnance Factories had achieved such changes before 1914 suggests that there was a knowledge concept within British management. This theme is further developed in the next chapter, which examines the management process, the functions and structures within the British Army and the Ordnance Factories more fully. This will include pieceworking and the principles of scientific management.

CHAPTER 6

**The Model Employer:
Management and Piece-working
and the Beginnings of Scientific Management
in the Government Manufacturing Departments
1855-1914**

Introduction

The aim of this chapter is to examine the management process, functions and structures within the Army and in the government manufacturing departments and especially the effect on labour relations. The structure of science, technology and management during the Victorian era may have been more advanced in the military than in the contemporary civilian world.

This chapter also examines the management functions within the Ordnance Factories generally, and the critically assesses the decentralized structure of the factories themselves. Much of the evidence comes from statements given to the Morley Inquiry (C 5110: 1887) by Lewis W. Engelbach, principal clerk to the Director of Artillery and Stores at Woolwich, and James McGee, manager of the Royal Small Arms Factory, Enfield. The Director of Artillery and Stores was an involuntary last stop clearing house for the Ordnance Factories, because no centralized management structure existed.

McGee's evidence was very much more at a micro-level, and his testimony explains the role nature and function of a manager within a Victorian factory, albeit an Ordnance Factory. Few details exist concerning the management or wage structures of private enterprise in the nineteenth century. This was a point succinctly made by Hobsbawm (1979: 357). Yet evidence contained in the Morley Report provides a clear picture of both management and wage systems which existed in the contemporary nineteenth century Ordnance Factories. This is why it is considered that the Morley Report is a very useful piece of primary source data for the business or management historian generally.

Other primary source data used in the compilation of this and the next chapter

includes obituaries, of superintendents and managers of the various Ordnance Factories. In particular, obituaries tend to exist for those who were members of the Institution of Civil Engineers, as these appeared in the Proceedings for the Institution. The obituaries appearing in the Proceedings also contain good data when attempting to assess the management function and abilities of those in charge of the Ordnance Factories.

The nature and structure of labour relations, including the piece-rate systems that were in existence at the time are all described in the Morley Report. These are referred to in this chapter, and where possible comparisons are made with the contemporary private sector.

Compared to the private sector, little has been written or researched into Victorian management of the public sector. The evidence contained in the Morley Report (C 5116: 1887), particularly from the military superintendents of the government manufacturing departments, the civilian managers and other civil servants, portray a small window into the hidden realms of Victorian management generally. The size of the government manufacturing departments were comparable to any contemporary private engineering company or railway engineering company. When assessing the management of the government manufacturing departments, the majority of the military superintendents were senior officers in the Royal Artillery or Royal Engineers, as were their military subordinates and this has been described previously in Chapter 2.

Civil servants who gave evidence to the Morley Inquiry had joined the service at the juxtaposition of the old and the new after the Northcote-Trevelyan Report. Lewis Engelbach who gave evidence to Morley, had originally been appointed as

junior clerk in the office of Secretary at War in 1854. Again there were numerous engineers employed at the government manufacturing departments who were of Scottish origin, and had attended Scottish institutions. These included the two Andersons, and Fraser. The cultural differences between the Scottish and English Universities was very pronounced. The Scottish culture was more sympathetic to science and technology. Also, Engelbach had received part of his education in Darmstadt Gymnasium and William Anderson, the first civilian Director General of the Ordnance Factories, had been educated at the Commercial School in St. Petersburg, Russia.

The principal personalities in the Ordnance Factories

Part of the purpose of this section is to suggest that not all Victorian management was based on the concept of the practical man. Although engineers such as John (later Sir) Anderson (1814-1886) were trained on the 'Practical Man' concept (Barnett, 1989), others did receive formal training. Though Anderson was born in Aberdeen (Scottish universities being more favourable to mathematics and science in the mid-nineteenth century than their English counterparts) he was apprenticed as an engineer to a local cotton mill. On the completion of his apprenticeship Anderson went to Manchester where he was employed first at Messrs. Fairbairn, Messrs. Sharp Roberts and Co. and then Mr. D. Napier of London, who had a contract to build a steam engine at the Royal Brass Foundry, at the Royal Arsenal. The Inspector of Artillery, General Dundas was impressed with Anderson and engaged him as an engineer.

Anderson worked at the Royal Arsenal for nearly forty years. In a biography of Anderson, Jeremy stated that:

"Apart from numerous technological contributions, Anderson was responsible for a thorough reorganisation of government munitions factories. He rearranged the sequence of the work process, introduced a system of wage differentials and brought in incentive payment schemes." (Jeremy, 1984, DBB, vol.1 (A to C): 58)

During the Crimean War, Anderson together with Robert Frazer (later changed to Fraser) designed the floating factory Chasseur, which became an extension of the Royal Arsenal being moored off Balaclava (WO 33/2A 41922). The experience of the Chasseur operating in the Crimean war zone exemplifies the concept of a growing military strategic philosophy of manufacturing and repair of ordnance and munitions within close proximity of the forward edge of battle area (FEBA). The concept of production and repair of military small arms by interchangeable processes whereby small arms could be repaired within the FEBA by semi- or unskilled military personnel was also part of this military strategic philosophy, which was initially realised in practice during the Crimean War (1854-6) and in the American Civil War (1861-5) (see Fernie's description of the Enfield Rifle Factory in 1862, Institution of Civil Engineers Minutes of Proceedings, vol.22, 1862-3; Cowan, 1997: 80).

HM Floating Factory Chasseur was managed by Robert Fraser. The Chasseur was a vessel of 500 tons, and was fitted with a 70 hp fixed engine, together with a 10 hp engine capable of being erected on shore. Chasseur housed a brass furnace and cast iron foundry and two saw mills. In its factory role, Chasseur made rails for the military railway at Balaclava, axles for rolling stock, and wagons used by the Land Transport Corps, repaired guns for the Artillery and Navy, both for the British and French Armies. The Chasseur was originally a collier, being steam and propeller powered. She had belonged to Messrs. T. and W. Smith of Newcastle-upon-Tyne.

Fraser too was of Scottish descent and at the age of fourteen was apprenticed

to William Clark of Sunderland. He supervised the construction of the Chasseur from collier to a factory ship and appointed the artificers of smiths, carpenters, engineers, iron-founders, brickmakers, brass-finishers and saddlers. For his services in the Crimea, Fraser was appointed first to the machinery department of the Royal Arsenal, then as manager of the Royal Gun factory (Proceedings of the Institution of Civil Engineers, vol.78, Part 4, 1883-84; see also Chapters 3 and 4).

Many notable members of the Royal Arsenal were involved in community and local issues, such as school board politics from 1870. Anderson became a juror at numerous International exhibitions and served first as a lecturer and then examiner for RMA Woolwich, the Royal School of Naval Architecture and the Arts and Science Department (Proceedings of the Institution of Civil Engineers, 1886: 346-3531). Anderson had been knighted in 1878.

The first civilian Director General of Ordnance was Sir William Anderson. Anderson's managerial education possibly occurred in Russia. He was born in St Petersburg, and lived there until his late teens and attended the Commercial High School at St Petersburg. In 1849, Anderson was enrolled as a student in the Applied Sciences Department at King's College, London, passing with distinction. Anderson began his business life in 1855 when he joined Courtney, Stevens and Co. of the Blackhall Place Ironworks in Dublin, where he was engaged in engineering and signalling work. Anderson was appointed as Director General in 1890. He also lectured on hydraulic machinery at the School of Military Engineering Chatham, and was an examiner at the Royal Indian Engineering College, Cooper's Hill. Anderson was an elected member of Woolwich council, and for Erith School Board. He was fluent in French and Russian and translated and abstracted for the Institution of Civil

Engineering's proceedings, original papers from the Russian, including Chernoff's researches in steel (Minutes of Proceedings Inst. CE vol.iv p.148, vol.ix p.220, vol. lxxxiv p.151). Davenport-Hines stated that "it fell to Anderson to implement the post-Morley reforms but it was his misfortune to take office just as the Navy Defence Act 1889 started an upsurge in armament orders and distracted attention from reform (DBB, 1984, vol.1 (A to C), biography by R.P.L. Davenport-Hines: 61).

The first chief mechanical engineer to the Ordnance Factories was Sir Hay Frederick Donaldson KCB (1850-1916). Donaldson was the second son of the first premier of New South Wales. Unlike the previous examples, Donaldson had been educated at Eton and Trinity College Cambridge, where he obtained an Arts degree. Donaldson then graduated from Edinburgh University in mechanical engineering. After which he was apprenticed to the London and North Western Railway Works at Crewe. He later attended Zurich Technical School, and returned to Cambridge for further technical training. His later career included rail and canal construction at Gore. On his return to Britain, Anderson was involved in the construction of Number 1 section of the Manchester Ship Canal. He then became Engineer-in-chief to the London and India Docks Joint Committee. Donaldson appeared to have encompassed the 'arts' and sciences in his academic career, which may have been due to his Scottish origins.

Management and the government manufacturing departments - the evidence of James McGee and Lewis W. Engelbach to the Morley Committee, 1886-1887

The management chain in the government manufacturing departments before the Morley Recommendations of 1887 were not well structured or cohesive. There

was no overall executive command. This role was loosely covered by the Director of Artillery and Stores based at Woolwich.

Surveyor General of Ordnance - political / politician
(an office formed as part of the Cardwell Reforms under the War Office Act 1870)

Director of Artillery and Stores (Woolwich)
Colonel RA (supervisory role only)

Principal Clerk - civil servant

Superintendent government manufacturing department
Lieutenant colonel RA

Assistant superintendent - civilian appointment

Manager - civilian appointment

Estimates branch
Chief mechanical writers - civil servants

Writers - civil servants

In 1886, the Secretary of State for War set up a Committee of Inquiry into the workings and structure of the government manufacturing departments. The Committee was chaired by Earl Morley, who reported in 1887 (C 5116). The superintendents of the Ordnance Factories, principal clerks and one factory manager gave evidence to the Morley Inquiry.

James McGee was manager at the Royal Small Arms Factory, Enfield, where he started as a fitter and gaugemaker in 1856. McGee's experience at the Springfield Armory was referred to in Chapter 3.

McGee's experience of the Springfield Armory included labour relations, sub-contracting of labour, and the status of intellectual property in the form of patents awarded to personnel employed at Springfield. McGee commented upon the number of skilled English labour employed at the Springfield Armory, notably blacksmiths and metal workers. However McGee confirmed that he had never visited any contemporary European arsenals,. But he did suggest that Enfield had the best machinery of "any manufacturing in Europe" (Morley, C 5116: 381, question 7889).

As manager, McGee could 'hire and fire' labour on the recommendation of the subordinate foreman. The military superintendent of an Ordnance Factory normally relied on the discretion of his civilian manager over such matters. There were, however, appeal procedures to the superintendent against any decision in the matter of labour hiring or firing made by the manager (Morley, 1887: 381, questions 7896-7898). McGee stated that as manager he would first hear what the man had to say before discharging or recommending discharge, though the disciplined worker had a right of appeal to the superintendent.

The time of the manager was divided equally between the factory and clerical work. McGee suggested that the clerical work was not heavy, and he had two writers subordinate to him to prepare, analyse and summarise the major burdens of administration. The most important aspect of the clerical work was the detailed accounts which were required annually by Parliament. To do this McGee also had four War Office clerks on the establishment to assist his in this task.

The Chief Clerk at Enfield was primarily concerned with accounts and wages. He was assisted by a subordinate cashier and stores accounts clerk. The foremen were the subordinate line staff under the manager, and McGee acknowledges that the role

of foreman as crucial to him conducting his duties properly as a manager. It was the foremen who calculated the piece rates through timekeepers, and was the link with the Inspection Branch. The foremen worked closely with the Chief Inspector, who employed viewers. The viewers inspected the work done. If properly made, and passed by the viewer, the artefact was counted, booked, and passed into the store. The men were only paid on work passed by the viewer.

The manager at each government factory was required to be in direct communication with the assistant manager, the foreman and with his line superior, the assistant superintendent. The responsibilities of the manager also revolved around the state of the engines and machinery within the Department. The manager could recommend the purchase of any machinery. The superintendent acting on his manager's recommendations would indent for the requisite machine. Any special machine for a specific purpose was made at Enfield. Bulk orders for machinery were generally placed on contract to a private manufacturer.

A shop was situated at Enfield for manufacturing special machinery. McGee did not think it economical if all the machinery for all Ordnance Factories were produced at Enfield (Morley, C 5116: 381, questions 7940-7946). Nor did McGee think it prudent for the Enfield Factory to manufacture its own steel as suggested by Morley. Expensive plant would be necessary particularly as rifle manufacture required mild steel based on the Siemens-Martin process (Morley, C 5116: 1887: 383, question 7939).

The manager was responsible for the numbers of workmen to be assigned to each foreman, and that the work was fairly apportioned. Any requests or recommendations for transfer, or any reduction or increase in labour had to be submitted from

the foreman in the first instance, via the manager, to the superintendent. The manager was also responsible for the submission of any proposed alteration in the piece-work rates, to the superintendent, who was the sole authority for any alteration. McGee had twenty-four foremen subordinate to him in respect of rifle manufacture, and a further five foremen responsible for the inspection and administration of the stores.

In comparing and contrasting the US Springfield Federal Armory and the Royal Small Arms Factory, Enfield, in McGee's opinion both factories "were working very much on the same lines" and "their machinery is nearly the same as that at Enfield" (Morley, 1887, C 5116, question 7846: 380).

A weakness in the pre 1887 structure of the government manufacturing departments was described by the Director of Artillery and Stores at Woolwich, Major General H.J. Alderson RA, CB. He revealed that there tended to be a want of connection and cooperation between each individual government factory. Indeed, each factory enjoyed almost total independence over its contemporaries, despite the interdependence of ordnance manufacturing generally. This lack of uniformity was manifest in the fact that disunity of action or even common strategic plan for the Ordnance Factories generally existed.

There were variations of current regulations affecting remuneration and other conditions of service for civilians employees. Each individual superintendent was responsible for the financial and administrative management of his factory. However this may have been due to the varying types of piece-work schemes undertaken at the Royal Small Arms Factories, compared to the Royal Gun Factory. The Royal Gunpowder Factory at Waltham Abbey and parts of the Royal Laboratory only worked on hourly rates, and never piece-work rates due to the volatile nature of the explosives

either in manufacture or testing.

The weak link of these almost independent five government factories was in the Director of Artillery and Stores who acted as a clearing house between the individual superintendents and their respective factories. The apparent weak link in the military chain of command, as is evident from the Director of Artillery and Stores, may be due to a number of factors. However, the most likely cause is that the role of the Director failed to evolve with the evolution of the Ordnance Factories after 1855. The original Director prior to 1855 fulfilled a similar though better-managed role over what were no more than workshops. Alderson informed the Morley Inquiry that:

"The superintendents are almost independent in their different departments, but each one refers to me every detail required. They come up to see me personally, or write to me, and very often if they want information from another department they make use of me, if I may use the expression 'as a post office'. They write to me and I have to write to the other superintendents, and backwards and forwards, and there is no way at present of putting the various departments in touch with one another excepting through my office." (Morley, C 5116: 1887: 413; also Hogg, 1963: 843).

The proposed solution to this was left to Engelbach.

Lewis W Engelbach CB,¹ Principal Clerk of the Director of Artillery and Stores in evidence to the Morley Committee, argued that a supreme director general should oversee all the government manufacturing departments. Their quasi-independent status was due to each department being formed at different times in history. Until the time of the Morley Inquiry, the Director of Artillery, based at Woolwich, was subordinate to the Surveyor-General of Ordnance though he had some 'arms

¹ Engelbach's eldest son Charles Engelbach OBE (1876-1943). Coventry Ordnance Works 1915-19, director Austin Motors Limited (see DBB, 1984: 288-90 and Chapter 8).

length' control over the superintendents of the various manufacturing departments. Engelbach emphasised despite the Director of Artillery's overall control of the superintendents, each superintendent had control of the internal workings and economies of their particular departments. There was a certain amount of dissimilarity between departments due to the varying areas of munitions produced, a point previously noted. In fact the Director of Artillery had only a general supervisory role over the superintendents.

The problem was that the Director of Artillery performed a multi-purpose role, in which he was, "jack of all trades and master of none". In Engelbach's opinion the duties of Director of Artillery and Stores had increased enormously in successive years (C 5110: 1887: 251, question 4292).

Engelbach put forward his proposal for a new overall post of "Inspector of Manufacturing Departments, or of a Superintendent of the Royal Arsenal." This officer should be a military officer based at Woolwich where the general administration of the five government factories would come under one head. The proposed supreme head of government factories should, in Engelbach's opinion, be subordinate to the Director of Artillery and Stores (question 4293). The Inspector of Manufacturing Departments,

"or whatever he may be called, would be a means of relieving the Director of Artillery and Stores of an enormous mass of detail which comes up to this office, and would at the same time save an immense deal of time and promote the unity of administration which would be an immense advantage to the public service." (C 5116: 1887: 251, question 4293)

In attempting to clarify what he thought the role of a proposed head of the government factories or of the Arsenal should be, Engelbach commented that a similar scheme had been twice previously attempted, unsuccessfully.

The first scheme had been planned some thirty years previously by John Anderson, chief mechanical engineer and Assistant Superintendent of the Royal Gun Factory. Anderson had originally proposed the appointment of a chief mechanical engineer post under an overall Director of the Royal Arsenal. This proposal had been submitted at the same time Anderson had recommended the location of the new Small Arms Factory on the Royal Arsenal site. Both proposals were rejected at the time by the then Secretary of State for War. Though in Engelbach's opinion both attempts had previously failed:

"owing to the opposition of the superintendents themselves the orders of the Secretary of State have not been carried out as intended: and therefore I have come to the conclusion that unless you give the new head of the Arsenal or the Superintendent of the Manufacturing departments, not only the power of controlling the superintendents, but also the knowledge of the departments themselves, it would be quite impossible for him to act successfully as the deputy or subordinate of the Director of Artillery and Stores without the difficulties arising which previously arose on the part of the superintendents in the fact that the superintendents knew more than it was possible for the head of the Arsenal to know, or to learn, and that therefore the head of the Arsenal as then intended was merely a buffer as it were between the superintendents and the Chief Director of Artillery and Stores; therefore I say that I think the head of the Arsenal must in fact be the superintendent of the factory so far as his military position is concerned ... practically speaking I should abolish the present superintendents to carry out my idea." (C 5116: 1887: 251-252, question 4299).

Engelbach felt that the proposed office should be held by a military officer, due to the military nature of the administration of the government factories, and the fact they produced munitions for the Army and Navy, as well as research and development of artillery and ammunition and explosives. Such an officer would need to instruct military and naval subordinates. In his assessment, Engelbach argued that the military superintendents of individual government factories would be abolished. Their role concerning policy being incorporated with the new head. The day-to-day

control of individual factories as currently undertaken by the superintendents and assistant superintendents being delegated to the existing civilian managers, who Engelbach considered should be elevated in status and remuneration. Indeed, Engelbach considered such a scheme would be popular with the 12000 men employed at the Royal Arsenal alone, who could appeal to the head directly. By suggesting this, there may have been some resistance by the civilian workforce to appeal to the military superintendent, via the proper channels, ie through the foreman, manager, assistant superintendent. Engelbach may have assumed that with a civilian manager cum superintendent, this line of command could either be formally shortened, or informally 'short-circuited'.

Engelbach considered that the proposed head of manufacturing departments need not possess any great technical knowledge. This was required for the existing military superintendents. The qualities of a proposed supreme Director General were sound judgement and leadership. In essence, Engelbach was proposing a function of executive management that was generalist rather than specialist. This became the model of the Higher Civil Service from 1855. It seems that Engelbach envisaged a civilian administrator as Director General, recruited and promoted from the Higher Civil Service.

However to balance the technical expertise at executive level, Engelbach considered that a deputy to the supreme Director General be appointed as chief mechanical engineer should be considered. According to Engelbach, the appointment should be made from civil mechanical engineers, rather than from the military. Engelbach's opinion here appears to be in the form of an upgraded position for the existing inspector of machinery.

There were existing examples of Engelbach's chief mechanical engineer both in the contemporary railway industry, and within the India Office and Admiralty. In Engelbach's opinion, the proposed chief mechanical engineer should attract a salary of between £1,500 and £2,000 per annum, together with a house. Morley reminded Engelbach that Sir William Armstrong had previously been appointed as "engineer of Rifled Ordnance at a salary of £2,000 per annum" (as superintendent of the Royal Gun Factory 1858-1862). Similarly Mr. George Rendel was appointed as civil member to the Admiralty. The whole of their time was required to be at the disposal of the Government. In reply Engelbach referred to Armstrong and his dual interest as director of the Elswick Ordnance Company. But Morley retorted that Elswick total output (1858-1862) was for the government only and not for any other client.

The idea of an office of Supreme Mechanical Engineer was probably influenced from the structure of contemporary railway companies who had chief mechanical engineers. Indeed when questioned about the salary proposed Engelbach acknowledged the remuneration of £5,000 per annum in the Public Service was of "an extremely limited character." But it had been brought to his attention that railway companies did pay that sum for mechanical engineers. Nevertheless Engelbach, whilst acknowledging that large salaries are paid in commercial life, conceded that in his scheme the honour which the post carried would be reward enough (Morley (C 5116, 1887, questions 4561-4564: 265).

With regard to the control of labour in the government manufacturing departments, Engelbach argued that civilian officers should be empowered to take on and discharge labour. In Engelbach's plan, the elevated managers would be the technocrats, along with the chief mechanical engineer, and a Chief Civilian Controller, with

civilian controllers in each factory would be responsible for the personnel function, the chief civilian controller being on the staff "of the Chief of the Arsenal" (Morley (C 5116, 1887: 29; summary of evidence, p.252; question 4304).

Piece-working and labour relations in the government manufacturing departments

Hobsbawm stated that, "We know so little about systems of management and wage-payment that it is dangerous to generalize about them" (1979: 357). Nevertheless they are central to the theme of this study. The evidence presented in this chapter has been obtained mainly from Parliamentary Select Committee Reports on Ordnance of 1862 and 1863, together with evidence given to the Morley Committee (C 5116: 1887).

Evidence suggests that piece-working was introduced into the Royal Carriage Department in November 1855 (WO 47/2755, p.1535). The concept of piece-working is crucial to this thesis, as the system is closely allied to costing interchangeability and scientific management. The introduction of piece-working into the Royal Carriage Department appears to have occurred independently of the Board of Ordnance Commission visitation to the American armories. However it seems to be synonymous with the introduction of machinery into the Royal Carriage Department. Steam engines were introduced into the Royal Carriage Department in 1855. De Fonblanque states there were twenty-three steam engines, "equal to 720 power, ... computed to be equal to the manual labour of 1200 men" (1858: 202).

Indeed, de Fonblanque commented that with the introduction of steam power into the Royal Carriage Department in 1855, 10,000 pairs of wheels were turned out in that year. Previously, in 1814, the Department by a great effort managed to turn

out 2400 pairs of wheels. De Fonblanque commented that, "the expenses of the staff of the establishment are less now (in 1858), than when it was comparatively in its infancy" (1858: 201).

Hobsbawm observed that until the 1830s economists treated wage-payment systems only incidently. From the 1830' however, economists began to pay more attention to wage-payment systems (1979: 357). In particular piece-rate systems began to be taken seriously along with other systems of Payment by Results (PBR). Both economists (such as McCulloch and Michael Chevalier) and employers "in several countries showed a marked tendency to extend payment by results, i.e. incentive payments - initially mostly in combination with sub-contracting and piece-mastering." (Hobsbawm, 1979: 357).

Again Hobsbawm suggested that due to lack of reliable statistics, the successes or otherwise, of these efforts cannot be accurately predicted. Hobsbawm also comments that "sometimes they failed among British engineers and builders" (1979: 357). Such schemes succeeded, including at Krupps where piece-work was introduced after 1850 along with mass production techniques. Other successes included in the new coal fields in South Wales. Hobsbawm suggests that the nucleus of acceleration of piece-working was the massive construction of the railway network in Britain and Europe (1979: 357). Surprisingly Hobsbawm does not include the experience of the American system of manufacture.

What is evident from Hobsbawm's research is that there may have been more than one source of influence. Krupp's were in a similar line of production to the British government manufacturing departments, and again, the government factories were closely allied to the railways. Therefore the introduction of piece-working into

the Royal Carriage Department may have come from sources other than America. The early failure of the British engineering industry to introduce piece-working may have been crucial to later attempts to reintroduce it during the 1890s.

The Molesworth Committee of 1855 also recommended the introduction of interchangeability and piece-working into the Royal Small Arms Factories at Enfield and Birmingham, giving two broad reasons for this recommendation. These were as follows:-

- It was considered in any manufacturing system to be advantageous to all parties where payment was made by the piece. However it introduced a system whereby labour was strictly controlled and monitored. Labour would be paid by the piece, and it would be an incentive in the interests of the employees to turn out as many standardised parts in quality as possible subject to passing a quality audit. The deployment of labour saving machinery which would promote the increase in productivity without compromise on quality was approved.
- The new system appeared to work with minimum supervision. The logic of this was that performance and productivity equalled with quality determined through inspection resulted in higher wages for the worker. Molesworth considered with this in mind, that workmen will not waste their time, through any reduction in output or decrease in the quality of output as this would reduce his wages, without loss to the employer.

Molesworth considered that where workers are paid by the piece this empowers them to be financially responsible for their own work and audit of such work. Any spoilt work caused would make the worker financially responsible. This method did

not work where payment was made by the hour, or day. This particular point is important when considering that the standardised parts made for the musket or bayonet were required to be identical, in order to enhance interchangeability.

The Molesworth Committee in consideration of these recommendations was impressed by the Board of Ordnance Commission's tour of the American Federal and private armories, where they had observed in both the, "Government and private manufactories ... piece-work, where it is applicable is universally preferred to day-work, as this yields the greatest amount of work at the least cost to the employer, at the same time paying him the best wages...." (Rosenburg, 1969: 196).

The Commission were equally impressed with the cleanliness of the workstations within the American armories both Federal and private. There were facilities for employees to wash and change clothing, and also canteen facilities were present. The workforce displayed regular attendance and sobriety.

The scope of the Commission's observations reflected on the industrial relations attitude within both the US Federal and private armories, particularly Remington and Colt. The notion of a payment through a process of piece-work is synonymous with the concept of costing. Perhaps an example of this can be seen later in American history and the first Henry Ford. Lord Leverhulme, in an address in 1922 at Manchester, suggested:

"Those of us who have an opportunity of comparing statistics in different works, find that the hard driver is not the organiser who can produce at low costs. There is a type of man, as foreman or manager or as head of a company who can bring the best out of a man - the biggest production at the lowest costs without any driving at all... Ford, last year [1921] is reported to have made ... 75 million dollars. We know that he paid in the process of making that money considerably more than the trade union rate of wages, in some cases double; but in every case over the trade union rate of wages; that they worked less than the recognised hours of most firms in the United States, and that the price

of his car is such that neither in this country, where our wages are less than half, nor in any other country in the world, can a car be produced of equal quality at anything like the price that Ford sells his cars. And having done all that - paid higher wages, worked shorter hours, sold his car for less money, he comes out with a profit which is said to place him as the man with the biggest income of any in the world." (*The Cost Accountant*, 3-9 December 1922: 213-4)

However, Leverhulme conveniently overlooked the fact that Ford's high wages were predicted on a maximum human effort (see Hounshell, 1984: 259).

The Board of Ordnance Commission visitation to America found in both government and private manufactories that payment through piece-work was the more preferred system for day-to-day work. It was considered that piece-work yielded the least cost to the employer, whilst at the same time paying the best wages to the employees.

On the recommendation of the Molesworth Report, the government of the day voted the sum of £40,000 for the, "immediate erection of the necessary buildings and machinery at Enfield" (de Fonblanque, 1858: 207).

However, in his description of the Enfield Rifle Factory, de Fonblanque writing in 1858 noted a "striking feature" of which,

"is the employment of machinery for the manufacture of the musket in all its intricate parts which has been most successfully adopted in the United States of America, but has not hitherto been attempted in this country ... some idea may be formed of the minuteness and nicety of the operations carried on ... from the fact that the musket is made up of between fifty and sixty pieces each of which requires special machines for its production; the bayonet alone undergoes sixty- seven distinct operations from the first to the last, and that the gunstock passes through seventeen different machines ... while only in the last stage, that of 'polishing', is manual labour resorted." (1858: 207).

Evidence suggests that interchangeability as practised in America and in Britain required 'filing down' in order for the interchangeable parts to fit. There is evidence to suggest that even the Colt revolver was not 100% interchangeable, even though Colt

himself claimed that they were (Institution of Civil Engineers proceedings 11 (1851-2): 30-68).

Hounshell (1984) argues that:

"Armory workmen filed and fitted machine-made parts while soft. When assembled, major components were stamped with serial numbers, the arms taken apart and the parts hardened. After hardening, the parts with same numbers were refitted by hand into a complete revolver. When considering the establishment of a small arms factory, the British Select Committee on Small Arms heard the testimony of a number of gunmakers and mechanics who had purchased Colt's pistols to see if they were constructed with interchangeable parts. None found them so constructed. The testimony of Colt's former superintendent, Gage Stickney, also damned the idea of interchangeability - 'I have heard of it, but I defy a man to show me a case'. All the British experts argued correctly that the process of hardening would throw off the fit between parts and that these hardened parts would have to be refitted with a file." (Hounshell, 1984: 49)

However, the solution to perfect interchangeability may have been one of the successes of the Royal Small Arms Factory, Enfield. John Fernie, in a paper delivered to the Institution of Civil Engineers on 19 May 1863 related that:

"In the year 1855 the old establishment at Enfield was broken up, and a new one was formed for the purpose of making rifles of the 1853 pattern, on the system established in America. The accounts for the year 1859-60 show that the number of rifled muskets which had been delivered into store was 87,405 on which there had been expended a total sum of £178,588.10s.7d, being the rate of £2.1s.8½d per arm; whilst the contractor's price for the same, at £3.3s.8d per arm, would have been £272,509.5s; thus a saving had been effected to £93,920.14s. A proper allowance for depreciation on tools and buildings was made, and no money value is claimed by the Enfield authorities on account of the arms being duplicates of one another. It is only necessary to see a rifle put together at Enfield thoroughly to appreciate the mechanical advantages of the duplicate system. Thus, the separate pieces which form the lock are picked up indifferently from heaps of such pieces, everyone fitting into its place most perfectly; and a rifle, the parts of which have never been together before, is formed in a few seconds from a lot of fittings promiscuously thrown together, as any lock will fit any stock, any stock will fit any barrel, and each part, however, minute, will fit any rifle. If any part be broken or requires replacing, there is a new one which will exactly fit it, so that wherever troops are armed with the Enfield rifle, there is not any fear of a

mischance through a bayonet not fitting, and the armourer's duty is confined to the exchange of a few duplicate cocks or springs; and, as it is only a system of exchange, a skilled armourer may be dispensed with. Whether serving in Canada, India or China, the various parts of that delicate instrument can be sent from home, with the certainty that they will fit the places for which they are intended, and thus there is a great saving of time and money, and the soldier is inspired with confidence in his rifle by the knowledge that it can be quickly made as good as new." (John Fernie, 'On the manufacture of duplicate machines and engines', Institution of Civil Engineers, vol.22, 1862-3: 604-5)

The reflections made by Fernie are similar to those of the American War Department some forty years previously. The small arms could be repaired on the battlefield and a skilled armourer would not be required to perform these repairs.

Rosenberg claims that Fernie's paper was a "plea for standardisation and 'duplication' of machinery parts in locomotives" (1969: 63, note 2). Fernie stated that it was not his intention to "describe the machines employed at Enfield" but suggested that "these examples are only intended to show that the system of duplicates both cheapens and improves the manufacture of all articles to which it can be applied" (Fernie, 1862-3: 605). However, Fernie did comment that:

"Until lately, little or nothing has been done in the application of this system to the manufacturing of machines, or engines on a large scale. It is true that the principle had been acknowledged and various writers had argued the desirableness of its introduction into the railway system; but with such large component parts special machines were out of the question, and the only other possible mode was working to a correct standard." (Fernie, 1862-3: 605)

The remainder of Fernie's paper explores the possibility of interchangeability being introduced into locomotive manufacture.

Fernie was locomotive superintendent at the Derby works of the Midland Railway. His obituary notice of 1904 states that he "introduced methods of fine measurement of work and established a system of duplicating engines whereby parts

were made readily interchangeable" (Institution of Civil Engineers, Minutes of Proceedings, 1904: 389). The same obituary also stated that Fernie was awarded a Watt Medal and Manby premium for his 1863 paper.²

Over twenty years later, McGee told the Morley Inquiry that inspection failures at the Enfield Rifle Factory were low. The inspection department at Enfield was outside McGee's jurisdiction but came under the direct control of the superintendent of the factory (Morley, C5116, 1887, questions 8060-8). At this time the standard rifle being manufactured at the Royal Small Arms Factory was the modified Martini-Enfield produced on interchangeable parts. This was a direct improvement on the previous Mark 1 Enfield Rifle Musket in 1855, as mentioned earlier in this chapter.

The introduction and promotion of piece-working schemes into most of the government manufacturing departments was quite remarkable. First there appears to be very little evidence that contemporary private engineering or Ordnance Factories could equal the systems operating in a public sector institution. Secondly, later writers on piece-working have ignored the role of the government manufacturing departments in pioneering this method of production and payment (Bienfeld, 1972; Cole, 1923; Hunt, 1951).

Hunt argues that:

"Only if management is efficient can labour earn the maximum bonus, and only if labour earns the maximum bonus (compatible with the maintenance of standards and the avoidance of undue fatigue) can management earn the maximum profits. Thus the interests of the two sides are made to coincide, and there is therefore a much better chance of success being achieved." (1951: 27)

² John Fernie 1824-1904. Member of the Institution of Civil Engineers, 1869. Born Cupar, Fife and served an apprenticeship to his father. In 1849 Fernie was appointed to the North Staffordshire Railway and in 1852 was appointed as manager of the Britannia Foundry in Derby, moving to the Midland Railway in 1855.

Fernie's application of interchangeability into the locomotive works of the Midland Railway Company from 1862 onwards spread to other locomotive works. The success or otherwise of interchangeability and pieceworking on the shop floor of a locomotive factory is difficult to assess. However, Williams, writing in 1914, stated that:

"Many of the methods employed, both in manufacture and administration, are extremely old-fashioned and antiquated... Small private firms are usually a long way ahead of railway companies in the matter of methods and processes, and they pay better wages into the bargain." (Williams, 1915; reprinted 1984: 45)

In terms of pieceworking, Williams observed that:

"Piece-rated men seldom or never work at a perfectly uniform speed; there are dull and intensely active periods depending sometimes upon the physical condition of the workmen and sometimes upon the quality known as luck in operation." (Williams, 1915; reprinted 1984: 237)

Williams also commented that the same speed and feed is required whatever the weather, especially affecting those who work over furnaces.

However, Williams comments that the process of pieceworking may have arrived much later at the GWR Locomotive Factory, Swindon:

"That great changes have taken place in regard to everything connected to the factory of late years is not to be disputed... New machinery has revolutionised many branches of the labour and it usually happens that where an appliance that saves 50 per cent to the firm is adopted the men are hustled into double activity; the great delight of the managers is to boast of the large amount of work produced by a machine, and to add that 'one man does it all'... The officials declare openly that piecework balance is merely given to the men when they earn it without strenuous efforts; they will not admit the reasonableness of working without any degree of sanity and comfort." (Williams, 1915; reprinted 1984: 376)

The introduction of piece-rate working into the private engineering industry, together with payment by results, reflects a trend towards a factory-orientated production process and a standardised product (Cole, 1922: 12-13). But its introduction into

the private engineering sector was a slow process due to union (ASE) militancy and the demarcation within workshop practice and management at the time. This is reflected in Williams' description (as above) in the GWR Locomotive Factory in the twenty years prior to 1914.

Cole, writing in 1922, commented that:

"The work done is still largely of a jobbing character, or even if processes are repeated, for skilled men at least the 'runs' are, as a rule, comparatively short. Consequently, new piece-work prices and basic times have constantly to be arranged for fresh operations, whilst the fact that machinery also is by no means standardised, that the price for the job has not infrequently to be modified in accordance with the character and equipment of the machine-tool on which it is to be done."
(Cole, 1922: 13)

The Royal Small Arms Factory, Enfield evolved into a factory-orientated establishment from 1858. This culture also quickly developed into the Royal Gun Factory, Woolwich, particularly under the influence of Robert Fraser, the manager of the gun factory. The Ordnance Factories generally were extremely successful in their piece-rate systems. Labour relations were excellent because the two operations of both the interests of management (the government and taxpayer) and of labour were complementary.

The expansion of rifle manufacture at Enfield through the process of interchangeability was from 1858 by a factory production system rather than by a workshop orientated process. A factory system implies that machinery for the main part is crucial to the production process. Labour tends to be deskilled rather than craft-orientated, thus concepts of the aristocracy of labour, labour control of the production process is greatly reduced if not eliminated. The labour process is controlled through supervision and inspection of the produced component, rather than the finished product. Other forms of control include accounting systems, clocking on and

off systems and a system of punishments (fines) and rewards. The pieceworking system, though not universal to a factory orientated production process, does adapt very well in this environment.

There is evidence to show that production of rifles at the Enfield Factory increased threefold within three years. "Up to 31 March 1858, 26,739 rifles were produced; between 1 April 1858 and 31 March 1859, 57,256 rifles; between 1 April 1859 and 31 March 1860, 87,405 rifles; and between 1 April 1860 and 31 March 1861, 99,083 rifles." (Rosenberg, 1962: 63 - quoted from Parliamentary Papers 37 (1857-8): 139; Parliamentary Papers 15 (1859): 217; Parliamentary Papers 41 (1860): 457; Parliamentary Papers 36 (1864): 607).

Unlike the Birmingham gun trade, the Royal Small Arms Factory, Enfield was manufacturing, under a system of mass production, the Enfield rifle musket Mark 1 for use by the British, Indian and Colonial armed services. The demand was perpetual and the constant production through interchangeability was at a price lower than through contract. The process continued throughout the nineteenth century with the Martini-Herny stop-breach load rifle introduced in 1869, the Lee Metford and eventually the short muzzle Lee Enfield rifle (SMLE) as used in both world wars. All the parts of these weapons were interchangeable, thus the stock, barrel, bolts, magazines and magazine springs of an SMLE could easily interchange with another SMLE.

The Birmingham gun trade produced to a small niche market, mainly based on sporting guns. These were made to order, on an individual basis, and were manufactured in a workshop / craft-orientated environment. The component parts were often manufactured through subcontracting arrangements.

The development of a factory system within the Ordnance Factories, first at

the newly reconstituted Royal Small Arms Factory, Enfield with the manufacture of rifles with interchangeable parts, quickly developed in other Ordnance Factories. The major architect of the new Ordnance Factories was James Alexander Cameron Hay, who served his apprenticeship under John Anderson at the Royal Arsenal, Woolwich (1847-54) where he became principal draftsman in the machinery department. Hay, under Anderson's direction, designed the Enfield Factory, the new Shell Factory (The Royal Laboratory) and the Gun Factory, both on the Woolwich site. Hay succeeded Anderson as Inspector of Machinery in 1874. He was elected as an Associate Member of the Institution of Civil Engineers on 2 March 1875, Anderson being his proposer. By 1894 Hay was Superintending Engineer and Constructor of Shipping at Woolwich, being also a Member of the Institution of Mechanical Engineers and a Fellow of the Royal Historical Society (candidate circular submission to the author by kind permission of the Archivist, the Institution of Civil Engineers, The War Office Staff List, 1894: 227).

The creation of a factory system at the Ordnance Factories which evolved into a structure of line and staff functions together with the introduction of attendant costing and accounting systems suggests that principles of scientific management could have developed there. The three principles assumed by Taylor - (i) the ownership of knowledge given to the managers from the workers, (ii) intellectual knowledge being centred in a planning or laying-out shop, and (iii) the task idea (Braverman, 1998: 77, 82) - appear to have been developed from 1858 onwards.

The system of scientific management also increased the clerical functions within the growing structure of the Ordnance Factories. The governance of the Ordnance Factories appeared to be centred within the clerical function. This growth of clerical

workers is needed within a system of scientific management which relies on data processing in order to keep records on the measurement of a worker's output, timekeeping, absence from the workbench and so forth, and to be able to convert this into monetary terms. Indeed, a scientific management technique could also be applied in the same way to a routine clerical function (Braverman, 1998: 221). Such techniques are crucial to the smooth operation of pieceworking and scientific management.

Cole's description reflects the British engineering industry immediately during the post-1918 era. The culture of the industry reflected a 'workshop' mentality, whereas the Royal Arsenal at Woolwich and the Royal Small Arms Factory, Enfield had previously in the nineteenth century changed to factory production both structurally and culturally.

The British engineering industry was still controlled by the mysticism of 'craft' through the ASE representing the aristocracy of labour. In such industries reflecting small-scale economies and objectives, it was also extremely difficult for scientific management principles, costings and labour utilisation through flexibility to be applied. This is a major cause for the concept of costing to be deficient in British management. This also persistently affected the recognition or status of cost accounts by the professional accounting bodies in the post-1918 era.

This can be seen in the struggle of the Institute of Cost and Works Accountants formed on 8th March 1919. Although supported by numerous industrialists, the ICWA was ostracised by the Institute of Chartered Accountants of England and Wales and by the Incorporated Society of Accountants who saw the fledgling body as a provider for traders and not for business. The ICAEW successfully opposed the idea of the ICWA of receiving a royal charter (*The Accountant*, 5 May 1923: 683; Loft,

1994: 129), or of a qualified chartered accountant advertising himself as an efficiency engineer (*The Accountant*, 28 June 1919: 552; Loft, 1994: 119; see also Chapter 5 and the experiences of Miles Taylor ACA).

It is evident that overall supervision under a payment by results system at the government manufacturing departments was not as strict as under a time-rate system, nor as oppressive as some PBR schemes became under Fordist practices of the earlier twentieth century. In fact under the PBR system of the nineteenth century government factories, there was a great sense of freedom experienced by many workers than under the previous piece-rate system. Equally PBR schemes attempted at the Elswick Company during the 1880s led to a number of strikes and lockouts.

Indeed Hunt suggested that the bitter resistance of the trade unions to piece-work was not reduced until after the First World War. During the 1920s attempts were made to introduce piece-working into collective bargaining (1951: 42). Having said this Hunt does point out that it was only during the Second World War that opposition to piece-work in the civilian industries was largely eliminated (1951: 43).

Evidence presented to the Morley Committee (C 5116: 1887) gives a wide perception of the operations of the government manufacturing departments from 1855 to 1886. A later Treasury Committee Report of 1907 (Murray, Cd 3626) continues with this, and reflects the systems of piece-working in the Ordnance Factories up to 1915. Though no actual statistics or wage calculation documentation exist, the evidence given to both Morley and Murray presents a more accurate picture than the contemporary private sector.

The evidence given to Morley reflected that of piece-working in the Ordnance Factories had existed there for the preceding thirty years. Much of this evidence came

from the superintendent of the Royal Laboratory, Colonel Barlow, and James McGee, manager of the Enfield Rifle Factory. Barlow identified two forms of piece-working at the Ordnance Factories:-

- Individual piece-work, and
- Fellowship piece-work (Morley (C 5116) 1887, p.184, questions 3129, 3130, 3131; see also summary of evidence, p.21) (in 1907 this was referred to as collective piece-work [Murray, Cd 3626]).

Collective piece-work was not unique or original to the government manufacturing departments. The practice probably evolved from farming and the growing use of gang-labour during the nineteenth century. Work was sub-contracted, or given to a piece-master who received remuneration for the work undertaken. From this lump sum remuneration, the sub-contractor, or his agent paid the members of the gang, for the total output of the gang, and not for the output of any individual.

In the railway manufacturing industry, fellowship pieceworking corresponded to piecemastering. Williams commented that this, or a similar scheme to piecemastering, was very unpopular in the Swindon locomotive factory:

"A few privileges attach to the post of chargeman, especially if there is a big gang; his wages are higher and he draws a sum called percentage equal to 10 per cent of his own weekly wages, deducted out of the 'balance' earned by the gang... The system of paying percentage is very unpopular with the rank and file of the workmen; whether the chargeman's behaviour is good or bad he is heartily hated by most of the men in consequence of it." (Williams, 1915; reprinted 1984: 254)

Group piece-work cannot be assessed in every aspect of output, either in mass production, or in job or batch production. The deficiencies of pieceworking included setting the correct rate. An incorrectly set rate could cause inflationary reaction, ensuing loss of competition. Cole commented that:

"The system theoretically in operation for fixing of the piecework prices was that of 'mutuality', or individual bargaining between the workman who was to do the job and the foreman or rate fixer." (1922: 57)

Unfortunately, the increase in premium bonus systems became somewhat ambiguous.

Cole again suggests that:

"In some cases at least, the employers took the view that the granting of the bonus was a purely gratuitous or ex gratia action on their part, and that either collective or individual bargaining about the amount of the bonus, or the basis on which it is calculated, would be out of place." (1922: 57-58)

Within shipbuilding group piece-work was applicable to riveting, or as Barlow pointed out to Morley it was common in the Shell Factory though not in the Cartridge Factory which undertook individual piece-working. At the Shell Factory, Barlow described that ten or more men would act as a team for fellowship piece-working. If part of the team was absent, then that worker would be fined, and the rate not paid to the absentee would be divided amongst the remainder of the fellowship (Morley, C 5116; questions 3130 and 3131: 185).

Barlow stated to Major General Goodenough,³ a committee member, that one man did not make a complete artefact but only a component part. Barlow described the individual piece-work system in cartridge manufacture:-

"... it would be divided up into several parts; one man will be working at the discs, and the costs go on the completed article; but supposing that a man turned out 500 discs he would be paid for those 500, and another man would turn out 560 and he would be paid for them, pro rata, according to the component parts of a cartridge." (Morley, C 5116: 185, question 3135)

It is apparent from Barlow's evidence that the average costing for piece-

³ Major-General Sir William Goodenough KCB. Inspector-General of Artillery 1885-86, previously Assistant Adjutant General, Woolwich Garrison.

working was a day and a third in one day. If the rate increased beyond a time and a third, then steps were taken to reduce the piece-rate. There was no set time allowed for this. Barlow commented that when discovered that the piece-rate was beyond a time and a third, then the shop manager's attention was drawn to it. Barlow suggested that reductions are made gradually (C 5116, questions 3150-3155, p.185).

Barlow in answer to a question by Mr. Carbutt, stated that both he and the managers of the government factories were all satisfied with the piece-work system now carried out.

Barlow in response to the Earl of Morley's request brought in books and other documents to the Committee to show how labour, piece-working and the workings of machinery were costed. These were consolidated in Appendix XIII and Appendix XIV of the Report.

The superintendent was directly responsible for the control of the budget allowed for Parliament, and was also responsible for promotions and appointments of subordinate staff, and in determining the rates of pay.

The Assistant Superintendent was responsible for order and discipline within the Department and acted as first auditor of piece-work earnings. In this respect, the Assistant Superintendent was assisted by a chief examiner and 36 subordinate examiners.

The Principal Clerk was responsible for the accuracy of the accounts, and payment of wages. Subordinate to the Principal Clerk was the Works Accounts Clerk, a senior clerk, who was in charge of the works account as follows:-

"He is responsible for the care of all extracts received from the Commissioning General, for the issue of the necessary orders to the manager for carrying out the services demanded ... for keeping a correct account of all the charges incurred on them....

He has charge of the work-taking branch and half wrought material stores and is responsible for the custody and correct account of all semi-manufactured articles sent into store, and that all work is properly taken up by the work-takers, and that the piece-work prices paid are in accordance with the approved rates.

He is responsible for the preparation of the 'C' forms of the wages accounts in time for the weekly payment of wages, and the value of the work performed during each week as per authorised rates corresponds with the total paid on the check books.

He keeps the principal accounts of the Department by the system of double-entry...

He prepares the annual balance sheet for Parliament , and is responsible that all documents in support thereof are properly verified." (Appendix XIII to Morley, C 5116: p.556, 'Division of Duties')

The actual wages, hours of work and other books relating to the operation of piece-work at the government manufacturing departments have not survived. However, the payment and wage records concerning time-rates at the Royal Gunpowder Factory for the years from 1892 to 1898 have survived. These records are water-stained which suggests that the others were destroyed during the blitz during the Second World War (Supp.5/431).

Under the principal clerk was the clerk responsible for stores and cash. The stores and cash clerk was responsible for the contract ledger and that all stores received by way of contract were inspected and passed as to quality and correctness in quantity. The stores and cash clerk verified all bills prior to payment, and verified the cost price of all materials on behalf of the works account branch. The stores and cash account clerk was responsible for the correctness of the nominal roll within the check book, and that entries to rates of wages, and proper medical reports to fitness were correct.

The check books contained a record of every worker's time,

"with his rate of pay, periods of sickness, and absences from all causes, and a weekly computation is made as regards day work of the wages due to each man. The hours for working being 54 hours are made. At the end of each week a return of extra time worked is furnished by the several branches for posting in these check books. No extra time is paid for until 54½ hours are made up. Extra time counts as time and a half for payment, excepting in the case of men who are only allowed common time for extra hours." (Morley, C 5116: 1887, Appendix XVI: 568)

With regard to piece-working,

"The amount of wages due to each man on piece-work is furnished through the foreman, through the manager, and these amounts must agree with the amounts arrived at by the Works Account Branch on the amount of work taken up by work-takers or sent into half-wrought stores." (Morley, C 5116: 1887, Appendix XVI: 568)

The cash account clerk was also to ensure that the 'ticket-check' was undertaken according to the established system. These pay tickets

"bear the same number as the metal tickets, the amount due to the man as per the check book for the week to which they relate, and are delivered up to the cashier at the pay table as receipt for the payments." (Morley, C 5116: 1887, Appendix XVI: 568)

McGee confirmed that the work at Enfield was chiefly piece-work, though it differed from that in the Royal laboratory described by Colonel Barlow.

Indeed McGee suggested that the character of piece-work at Enfield rendered it more easy to fix the "proper piece-work prices than at Woolwich" (Morley, C 5116: 1887: 50), though usually it is not easy to fix the correct rate at all. McGee suggested that the Enfield prices only required a revisory process when improvements within the manufacturing process were made. He commented on the piece-work prices of the Martini-Henry rifle had considerably changed due to recent improvements in the tooling up and machinery improvements. McGee suggested that improvements within a manufacturing context were ongoing at Enfield.

However, McGee stated that men at Enfield under the existing system of piece-

rate earn 35 shillings a week, whilst others doing the same work only earn 25 shillings a week. He suggested that the established time and a third rule contributed to this anomaly at Enfield, but conceded that less supervision was now required; "... men had reached the limit they would not try to do more" (Morley, C 5116: 1887: 50). But under this system more work was derived from machinery, McGee also stated that the price of piece-work is "only reduced when improvements in machinery is introduced" (Morley, C 5116: 1887: 50).

At Enfield in 1886, the men also worked a fifty four hour week, similar to their colleagues at the Royal Arsenal, Woolwich. The recent introduction of new machinery at the Enfield Rifle Factory allowed the working day to be reduced from ten hours to nine hours. McGee also commented that the

"reduced cost of manufacture of rifles is chiefly owing to improvements in machinery. The new machine for boring rifle barrels was a Belgian idea, perfected by Greenwood and Batley and at Enfield. The manager was encouraged to improve designs to contract machinery for use in the factory." (Morley, C 5116: 1887: 50)

McGee stated that the craft labour at Enfield, particularly tool-makers, fitters and blacksmiths, did belong to trade unions (Morley, C 5116: 1887, question 7728). McGee reiterated that trade union membership was passive. He knew of no foremen who were trade unionists. In McGee's opinion workmen who were members of trades union were not prejudiced in any way (Morley, C 5116: 1887: 378, question 7738). The only resistance to change had been quite mild. McGee reiterated the background to this, when "some time ago it was decided to have one man to look after two machines simultaneously" (used for planing Gatling machine guns). There was some initial resistance on the part of the men, who were trade unionists, "but they finally consented to do the work as required. No further difficulty had been encountered with

the men" (Morley, C 5116: 1887: 51).

There is no evidence that there was any industrial action within the government manufacturing departments. No evidence to support this is to be found in any primary source evidence, including the Times newspaper. By contrast the growing industrial unrest at the Elswick Company during the 1880s and 1890s was regularly reported in the Times. Therefore McGee's observation that trade union membership in the government manufacturing departments was passive, is probably correct.

The systems of piece-work at the Enfield Rifle Factory tended to be individualistic rather than collective. However McGee was challenged whether pressure is brought upon an individual to reduce their output. McGee felt that the incentive of bonuses suggested that each man is trying to get all he can" (Morley, C 5116: 1887: 377, question 7717).

But McGee did suggest that in other Departments there may have been an understanding "among the men that they shall not go above a certain rate". Nevertheless, McGee reiterated that this did not occur at Enfield for "the men are working for themselves and not for any union" (Morley, C 5116: 1887: 377, question 7718). In responding to this, McGee gave an inclination of the origins of the workforce at Enfield.

"Some of them perhaps would be shoemakers, and some of them bricklayers, and some of them bricklayers' labourers, or some of them working in the fields before we get them, so that they came in with the intention of getting what they can." (Morley, C 5116: 1887: 377, question 7718)

Adult male labour employed at the Royal Laboratory, about five sixths were paid on piece-work rates, single or collective. The Murray Committee recognised that the "'Rowan' system of premium piece-work was used to a certain extent" (Murray,

Cd 3626: 1907, para.6). The Murray Report also commented that the Royal Carriage Department employed by skilled and unskilled labour on piece-work rates, either on individual or collective schemes (Murray, Cd 3626, para.12). These rates were settled by a special rate-fixing branch of the Carriage Department. Evidence presented to the Murray Committee suggested that these rates worked out at about 30 per cent more than the time rate fixed for each man.

Hinton stated that:

"An alternative method of containing wage inflation was the Premium Bonus system, whose acknowledged objective was 'to obviate the necessity of rate cutting by so arranging the piece-rates that the workmen could never earn excessive wages'." (1973: 89; see also MUN 5/82, Payment by Results, 1919)

Instead of a piece being fixed for each job, a standard or basic time was fixed. Hinton argues that the most widespread system was the Rowan premium bonus system, which was devised in order that earnings could never reach double time. Also the increase in earnings slowed down as the worker increased his speed. Again Hinton argues that the Rowan system was extended particularly on the Clyde. However, Hinton confuses the Rowan system with the earlier Hasley system by suggesting that it was the Rowan system that "had originated as an American import in the late 1890s and at the Vickers works in Barrow". The Rowan system was initiated on the Clyde, it was not imported from America. Cole (1922) confirms this, suggesting that "before the war [1914], a few shops had introduced the premium bonus system, usually the modified Rowan system originally devised upon the Clyde" (1922: 64).

Again, Hogg (1963: 906) suggests that the experimental premium bonus system used at the Royal Laboratory was discontinued due to its dislike by the workers and trade unions. This is not supported by the original evidence, however. Murray (Cd

3626, 1907) confirms the use of the Rowan system at the Royal Laboratory.

The origins of the Rowan system began in 1898, being a premium bonus system begun in the Glasgow marine engineering firm of David Rowan and Co., the actual inventor being James Rowan. The Rowan system was designed to eliminate arbitrary rate cutting. To achieve this, a price was fixed for each job and a standard or basic time was fixed. For each hour the worker saved in the operational performance of the job or task undertaken, he was paid some proportion over his hourly rate (Hinton, 1973: 89). The Rowan premium bonus system was designed in order that earnings could never reach double time. Also the increase in earnings slowed down as the worker increased his speed (Hinton, 1973: 89). This reduces the possibility of deliberate restriction of output, whilst encouraging the employer to increase the efficiency of his plant or factory (Hunt, 1951: 81). It must be noted that the Rowan system was only adopted in certain British shipyards at the very end of the nineteenth century, some three decades after similar systems had been introduced in the Ordnance Factories.

There is no evidence that any deliberate restriction of output occurred at the government manufacturing departments. This had been stated in the Morley Committee by McGee as has been previously stated.

However, there is some evidence that the system of piece-working as described by McGee to Morley tends to reflect a similar premium system as devised by Hasley. The Hasley premium bonus system was introduced by F.A. Hasley, an American engineer, who was superintendent of the Royal Drill Company of Sherbrook, Canada (Hunt, 1951: 79). Hunt suggests that Hasley's method was first introduced into British industry by Messrs. G. and J. Weir of Cathcart (1951: 79). Yet McGee's evidence

suggests that a similar system was universally being used at the Enfield Rifle Factory some years before 1890.

At the Royal Gun Factory, the majority of the labour force reflected highly skilled labour who were paid mainly single piece-work rates. However for some operations the collective piece-work system was often adopted. Murray in 1907 concurred with the Morley findings some twenty years previously that "the practical result of the system of piece-work rates is that workmen earn one-third as much again as they would on time rates" (Murray, Cd 3626: 1907, para.8).

Originally the industrial workers at the government manufacturing departments did not have the status of civil servants, and as such did not originally belong to any government superannuation scheme. Managers, foremen and writers were only admitted to the superannuation scheme from 1906 and all industrial workers had to wait until 1911 for entitlement under the National Insurance Act.

But the workers also enjoyed benefits which were not universally in the contemporary private sector. Sick pay was allowed, for which the employees paid one penny in contribution into a sick fund (Morley, C 5116: 1887, questions 7704, 7706).

The following rates applied,

"If injured, full pay for a period not exceeding three months is allowed on the certificate of the principal medical officer, the foreman also certifying that the accident was not the result of carelessness.

If sick, the men are entitled to pay as follows:- half-pay after three years service, with the exception of foremen, who are allowed full pay, to be issued for no longer continuous period of one month, and not for more than two months in one year, except under special circumstances when the superintendent has authority to grant up to two months to men over 10 years service, and up to three months continuous to men over 15 years service." (Morley, C 5116: 1887, Appendix XVI: 568).

The origins of sick pay in the government manufacturing departments had

originally been approved on 9 March 1855, the War Office authorised sick pay to artificers and labourers in the original departments of the Inspector of Artillery and in the Brass Foundries (WO 47/2752, p.853).

This was long before the Employer's Liability Act of 1894. The Financial Secretary to the War Office, W. Woodall in answer to a Parliamentary question in 1894 stated that,

"there is no intention of altering the present arrangements for injury pay to which all workmen of the Ordnance Factories are entitled although the Employer's Liability Bill now before Parliament is made to apply to any such workmen as if the employer was a private person." (*The Times*, 4 May 1894).

There is some suggestion that Woodall described the injury pay scheme at the Ordnance Factories was the model for the Employer's Liability Bill. He commented further that, "There will be no objection to lay upon the table the rules of the Ordnance Factories under which injury pay is granted" (*The Times*, 4 May, 1894).

The labour at the government manufacturing departments was not casual. Lewis Engelbach informed the Morley Committee that he had never known a case of labour being discharged from the various departments towards the close of the financial year, due to a lack of funds to keep them in employment (C 5116: 1887, summary: 28, and question 4147-4148: 244).

From the evidence given to the Morley Committee, it is apparent that the Ordnance Factories were highly organised and bureaucratic institutions. The supervision within the government factories was not severe, whereas discipline in a workshop environment often was. To illustrate this, Hobsbawm quotes one of F.W. Taylor's disciples, "We used to drive workers but - especially if they are skilled - they do not have to stand it" (Hobsbawm, 1979: 358, quoting C.B. Thompson, *Scientific Manage-*

ment 1914: 684). The concept of scientific management evolved from the process of interchangeability and the factory system. Therefore it is probable that this is why Ordnance Factories innocently adopted scientific management before Taylor.

One can reflect on the comments made by Professor J.G. Smith in his introduction to Roll's pioneering study on the Boulton and Watt Foundry: "Neither Taylor, Ford nor other modern experts devised anything in the way of plan that cannot be discovered at Soho [The Birmingham factory of Boulton and Watt] before 1805 ..." (quoted by Urwick and Brech, 1953, vol.2: 24). Urwick and Brech clarify Smith's observation by suggesting:

"What Taylor did was not to invent something quite new, but to synthesise and present as a reasonably coherent whole ideas which had been germinating and gathering force in Great Britain and the United States throughout the nineteenth century." (1953, vol.1: 17)

Indeed, Urwick and Brech suggested that:

"A study of the methods of control practised in the Boulton and Watt Foundry in 1805 or described in Slater Lewis's book in 1896, suggests that Taylor was not so much a pioneer in a completely new field, as one who made a new synthesis out of old practices. He isolated and defined the fundamental principles underlying good management in industry, principles which had been applied for many decades but had not been fully recognised." (1953, vol.II, pp.8-9)

One historian of scientific management suggested that there "now had to be 'a substitute for the effective supervision characteristic' of the small shop" (Person, 1929, *Scientific Management in American Industry* (NY) 7, quoted by Hobsbawm, 1979: 358).

Thus, Hobsbawm stated that "'Scientific Management' was the result" (1979: 358). Again Hobsbawm considers that scientific management in its:

"initial phases ... consisted of three elements

- a) a careful analysis of the production process, its break-up into

simple segments and establishment of labour norms for each;

- b) a system of costing which enabled the firm to discover the labour cost of each operation and to keep it under constant observation;
- c) the elaboration of systems of incentives or supervision capable of making workers labour at maximum intensity. For practical purposes, this then meant payment by results." (Hobsbawm, 1979: 358).

A fourth element in the success of scientific management was by the long production runs of output specified to a standard design.

This relates well to the internal economy of the Ordnance Factories as follows:-

- The use of work marks, and all expense direct and indirect were charged to the appropriate work mark. The team work mark could equate to what is a cost centre in the late twentieth century.
- The continual use of piece-working. The control, recording and monitoring of the workers, suggest that there was a measured output per worker. The use of team working which can either contribute towards team effort and encouragement, or, alternatively suggest that a worker's fellow peers may be his police and monitoring agent.
- The clear lines within the division of labour suggest that there was a degree of scientific management within the government factories. In this respect, the government factories tended to put more emphasis on the role of Department manager, than the contemporary private sector and that accounts and the transmission of regular financial and numerical information was crucial to the decision making role of the Superintendent, the Assistant Superintendent and the Manager. The employment of mechanical writers is also suggestive that their role also may have included costing calculations.

There is also the evidence of McGee, which suggests that a number of skilled craft workers at Enfield by 1886, were now allowed to be members of trades unions. This is a reversal from the policies of thirty years previously. In particular were the recommendations of both the Molesworth (1854-55) and the Monsell Committees of 1862 and 1863 which were categorically opposed to trade union membership. The issue of trade union recognition is covered in the next chapter. The establishment of Fair Wages Resolutions from 1891 also affected government employees, particularly unskilled workers in the War Office or the Admiralty.

There were differentials in piece rates and wages generally between the Royal Small Arms Factory at Enfield and the Royal Arsenal at Woolwich. The matter grew into a grievance procedure which was investigated between 1906 and 1911. In particular, the unskilled workers at Enfield, represented by the Small Arms Workers Union, complained that the differentials in payment between workers at Enfield and at Waltham compared to those at Woolwich and Pimlico contravened the Fair Wages Resolution.

A conference in respect of the minimum wage levels for War Office and Admiralty employees was held on 14 February 1911 which concluded that:

- "1. The minimum rate at Enfield and Waltham should be 23/- as now, the report of the Admiralty Committee not justifying any increase.
2. The minimum rate at Woolwich and Pimlico should be raised to 24/-. This would necessitate a similar rise at Deptford and the West India Docks.
3. These minimum rates are to apply in future to quite unskilled labour only (such as fetching and carrying or sweeping and cleaning); all men, the nature of whose work requires them to display any special skill or to bear any special responsibility are to get more." (WO 32/9275)

Under the Fair Wages Resolutions, the transfer of contract or sub-letting also required the payment of the minimum wages as set, and the contractor was responsible for the observance of the Fair Wages Resolutions by the sub-contractor. There are numerous examples contained in the Annual Reports of the Director for Army Contracts between 1891 and 1913, of contractors being removed from the Army Contracts Department list for non-compliance with the Fair Wages Resolutions. The differences in the levels of the minimum wage rates between Waltham and Enfield, compared to Woolwich and Pimlico were given as the differentials in the cost of living as calculated from the Board of Trade statistics.

The general philosophy behind the government manufacturing departments suggests that they reflected model business ethos, rather than the contemporary private sector. It is worth reflecting, when considering this, the findings of the Board of Trade Report in Changes in Rates of Wages Hours of Labour in the UK. For the Industry of Engineering and Machinery Works, District XIII for Kent and Surrey (Extra Metropolitan), Berkshire and Hampshire, sub paragraph b) stated that, "A few Returns giving piece-rates were received and from these, the piece-rates appeared to be nearly 30 per cent higher than the time rates" (BPP, 1894, LXXXIII, Pt.2, p.56). It would appear from this that the piece rates were being set by the trade unions, notably the ASE, and not by the management. This is a complete contrast to the systems at Enfield and Woolwich.

Conclusion

This chapter has examined the management structures and the growth of pieceworking within the Ordnance Factories from 1855. The scope of this chapter

has focused more so at the macro level of management structures and bureaucracies because this is where the majority of the primary source evidence lies. Little has been recorded which has survived the passage of time which can give an in-depth study of the micro factors of management within the government manufacturing departments.

Having said this, one should not under-estimate the data which exists in Parliamentary select committee and other reports of the time, notably Monsell (1862, 1863), Morley (1887) and Murray (1907), which give a clear picture of the macro structures of the Victorian Ordnance Factories and of the personalities behind them. This is equally important. Names and experiences of managers such as James McGee would be unknown to the future historian, save for the recorded evidence and experiences to the Parliamentary Reports for 1862, 1863, 1887 and 1907.

The following chapter explores the recommendations of the Morley Inquiry, and subsequent inquiries particularly during the period from the post-Anglo-Boer War period to 1915. Parts of the Morley recommendations were not fully implemented. After 1902, the effects of the Esher Reforms restructured the high command of the Army to reflect a twentieth-century organisation. However, at a micro-level the Esher Reforms reintroduced layers of bureaucracy in the system of munitions procurement which had previously been abandoned in 1855. The Esher Reforms together with the Treasury sponsored Murray Report of 1907 reflected the retrenched politics of a post-war economy ultimately leading to the shell scandal of 1915. This concept is discussed more fully in the next chapter.

Yet the earlier internal reforms of the Ordnance Factories, as they were to be known during the post-Morley era), promoted the 48 hour week (average 8 hour day) within the majority of government departments from 1894. In the case of the Ord-

nance Factories the introduction of a 48 hour week was the full recognition of rational labour utilisation through scientific management.

CHAPTER 7

‘The First Flight of Employers’ Centralisation and Industrial Relations in the Ordnance Factories 1887-1914

Introduction

The aim of this chapter is to follow on from Chapter 6 and analyse the industrial relations dimension of the Ordnance Factories. To start with, we continue with evidence from the 1887 Morley Committee Report.

From the recommendations of Morley, the management structure of the Ordnance Factories was developed. This process took the form of centralisation of the management structure and the identification of an overall head of a centralised Ordnance Factory structure. These reforms relieved the Director of Artillery and Stores of overseeing the informal stopgap clearinghouse functions of the Ordnance Factories.

The introduction of the 48-hour week in all but one of the Ordnance Factories settled both sides of an enigmatic equation. First, on one side, the management of labour utilisation and the need for increased productivity, on the other side was the consolidation and reinforcement of the trust culture, with all its prevailing attendants. The contemporary private sector were not so fortunate. The private engineering industry was becoming embroiled in a growing and acrimonious industrial relations conflict. Though masked in a cloak requesting for an eight-hour day, the eventual strike and lock out in the engineering industry dispute of 1897 was more to do with the machine question, the use of semi-skilled operatives, and the employer's right to manage. These were issues which had been resolved long before in the Ordnance Factories.

The Committee of Inquiry into the Government Manufacturing Departments (the Morley Committee, C 5116) reported in July 1887. The final report was divided into three parts.

- The first part gives an outline of the system in operation in 1886.
- The second part reports on the weakness in the existing system.
- The third part of the Morley Report puts forward recommendations for redressing the apparent exposed weaknesses.

The weakness of the existing system as it existed to 1886

- **Decentralisation**

The weakness of the existing system up to 1886 has already been stated through the evidence of Major General Anderson, Director of Artillery and Stores, and his Principal Clerk, Lewis W. Engelbach.

Again further weaknesses were exposed in the system that prevailed until 1886 by Evan Nepean, Director of Army Contracts. Nepean in evidence to the Morley Inquiry reflected on the earlier Cardwell reforms when:

"In 1868 [he] began those investigations which ultimately led to the formation of the present Surveyor-General's Office [Surveyor-General of Ordnance]. In the year 1869 I became responsible under Sir Henry Starks and General Balfour for the work connected with the establishments of the manufacturing departments, as there had never been an inquiry [before] ... Sir Henry Starks was very anxious to know something about their interior economy, and he ordered a letter to be addressed to all heads of department, in which [he wanted to know about] what they did about wages, ... what rates they paid, and whether their piece-working rates were much above their day rates, and generally speaking what their system was. That was met by the heads of manufacturing departments at the time with some opposition. They said, 'You have no business to interfere with our internal economy and management, and we submit that we should not be required to furnish any' ...

A committee was then appointed to go thoroughly into the details. That committee consisted of Sir George Balfour and myself [Nepean], and Mr. O'Neil, a principal clerk in the Accountant General's Department, who left the Service some 15 years ago. We went into all the manufacturing departments ... we received ... every assistance from the superintendents of the manufacturing departments and we

found that there was really nothing to conceal ... no report was ever made of our proceedings, but I can assure the Committee that a report was drafted which would have been satisfactory and favourable to the departments in every respect if it had been presented." (Morley, C 5116: 1887: ch.3606-3607, 205).

No action was ever taken on this earlier report.

The co-ordinating level was by a very narrow level of senior management, through the Director of Artillery and Stores. However his parameters of responsibility and authority were by no means clear. The structure was sound if the prevailing environment was stable. Problems arose when conditions became more unstable, for instance producing in a war time economy or international crisis.

The problem as stated by Nepean over the previous Balfour Report, saw the individual manufacturing departments becoming threatened if there was any threat of change, or perhaps flexibility intruding into the stability of an inflexible status quo, for example in a war setting. Handy (1993: 186) suggests that:

"Organisations used to be operating in a sellers' market until the mid 1950s, or with the state as their only customer, were quite properly operating as a role culture since there was a high premium on product reliability, and few penalties for cost or lack of product innovation."

Handy's thesis is evident from the nineteenth century pre-Morley reforms. Nepean in his evidence summarised the role of the Director of Contracts concerning the specifications for orders which was the responsibility of the superintendents concerned, after approval with the Ordnance Board. The contractor could not alter, or restructure the order. This was in response to Messrs. Armstrong, who attempted to alter the specifications of a contract for gun carriages after the order had been placed by the Army Contracts Department. Indeed Nepean suggested that if the contractors were allowed to alter specifications after contracts had been placed, this could be at the sacrifice of interchangeability (Morley, C 5116: 1887: questions

3701-3734, pp.213-214). This comment suggests that interchangeability was not universally practised in the contemporary private sector.

Nepean explained to the Committee that his duty with regards to contracts ceases when the contract is completed. With important contracts, the Director has to report showing how the contract has been completed, and whether the delivering contractor should be recommended again for future tenders (Morley, C 5116: 1887: question 3740, p.214). In response to a question from a member of the Committee (Hon. Guy Dawney), Nepean stated that it was the head of the receiving department responsible for the quality of any article delivered, and that the Director of Army Contracts has no further responsibility in this matter.

- **The quinquennial changes of superintendents**

As the superintendents of Army manufacturing departments were staff appointments in the Army, they only held office for five years. It was considered that five years was not long enough for a military superintendent to acquire the knowledge of factory organisation and manufacturing processes.

All superintendents however had to have passed the Advanced Class, and have served in the Army Manufacturing Department within a subordinate position. These posts were connected with inspection or instructor duties rather than administrative office.

The assistant superintendents acted as deputies to the superintendents of the Ordnance Factories. They were civilian managers rather than military officers as were the superintendents. The civilian assistant superintendents had more of a permanent position than the superintendents and tended to be better acquainted in the

administrative procedures governing the Ordnance Factories.

The five year succession of superintendents therefore meant that equally there was a succession of breaks. When one superintendent had been guided through the learning curve under the guidance of a more permanent civilian assistant superintendent, then he was replaced, and the whole process had to begin again.

Indeed the five year cycle through the learning curve was unproductive.

First year	induction - mentored by Assistant Superintendent
Second year	supervised control
Third year	perhaps the most productive year
Fourth year	complacency - the following year would be a return to regimental duty.

There were advantages to the limited tenure of commissioned officers as superintendents of Ordnance Factories. For example, most were officers of the Royal Artillery and had more than a working knowledge of ordnance, artillery and the sciences appertaining to these specialisms. Many superintendents had also spent a large part of their military service within the Ordnance Factories both in England and India.

If, however, the post of superintendents of Ordnance Factories was civilianised, then officers would be deprived of an incentive to enter the Advanced Class. Thus any scientific attainments either previously or contemporaneously gained by officers would generally deteriorate. Alternatively officers of the Royal Artillery and Royal Engineers who were some of the most highly trained officers in the Army would be lost if they decided to seek an alternative career in civilian life in order to pursue their planned career aspirations. This was a point made in Chapter 2

concerning former military officers who, through the frustration of career prospects in the Army and Navy, had left the services to become railway managers.

According to the Committee, therefore, that the government factories existed for supplying the Army and Navy with warlike stores in the most efficient and economic manner. They were not constituted to provide well paid positions for Artillery officers. The Committee also believed that if limitation were to be removed from certain posts connected with manufacture, there would, under new proposals, be a sufficient number of technical appointments which would induce Artillery officers to pursue their scientific studies.

Artillery officers reflected the 'users point of view' of warlike stores, and it was argued that this was essential qualification for a manufacturer of such stores. However this may not have been technically true, a point realised by the Committee. The Morley Committee noted that military experience was undoubtedly of value in indicating broad lines of designs and in inspecting finished products. However, military experience tended to be of little value in manufacturing warlike stores to a specific design which had to undergo rigorous research and development. The skills and characteristics for this specialised process was more generally acquired in civil than in the military world. Captain Noble, who was in favour of retaining military superintendents, did admit in his evidence that,

"in actual manufacture military knowledge is not of great importance and that the government ought to be able to command the very best mechanical engineering ability that is to be had, but doubts whether that is always the case." (Hogg, 1963: 845)

The rationale behind Noble's argument is that the majority of the government manufacturing departments were staffed by civilians. However, Noble was referring to a similar point put forward by Engelbach, that is the appointment of a Chief

Mechanical Engineer. His doubts, perhaps, refer to the experiences of Engelbach in relation to salaries paid to the chief mechanical engineers of contemporary railway companies. Noble's argument possibly reflected the prevailing viewpoint within the War Office and supports the notion that the concept of the soldier-technologist was not a major influence in the broader structure of British management, unlike the American experience.

- **Inspection**

The Committee argued that the manufacture of munitions should be inspected twice: once whilst being manufactured to test quality control, the second inspection should occur after the munitions had left the place of manufacture. This second inspection was to proof and test the munitions on receipt into the Ordnance Stores of the Army and Navy. These inspections were required to ensure that the contract for manufacture met the specifications and that the public were getting value for money. The first inspection could be made without intruding upon the responsibility of the manufacturer. The reasons given by Morley included:-

- a) Both the government factories and private manufacturer would test the material he received, as well as the manufactured commodity in order to satisfy himself as to their quality and conformity both during and after manufacture. Certification to the Secretary of State, to the effect that the finished manufactured goods conformed to requisite tests and conformed to contract. The first inspection should take place at the place of manufacture.
- b) All procurements produced under contract by private ordnance companies were transported to the Royal Arsenal for its first inspection and proofing.

The cost of conveyance was borne by the contractor. Despite this, initial inspections at the place of manufacture were undertaken by government inspectors (called viewers). This procedure was enacted on the recommendation of the second Monsell Report of 1863. This procedure, however, did not relieve the contractor from responsibility.

Private contractors were in a different situation to that of superintendents in charge of government factories. Lord Herbert, some thirty years previously had argued that the aim of the contractor was profit motivation. Thus it was incumbent on him to produce his warlike stores as cheaply as possible compatible with their passing inspection.

If the contractors' products failed on service, the remedy via the Director of Army Contracts was to remove his name from the list of approved contractors. Thus, the private contractor could not afford to take undue risks. The profit motive kept him on the straight and narrow path.

The government manufacturing departments did not have this inducement to produce cheap work. They operated in a protected market, free from competition. The employment of those in the government factories was long-term, and could not be suddenly terminated.

Despite this apparent criticism, the superintendents of the manufacturing departments were subject to forms of competition in that they competed through the Army Contracts Department with the private sector. Indeed, the Army Contracts Department did form special relationships with certain private manufacturers. Trebilcock notes the relationship with the cordite companies (Trebilcock, 1969). Superintendents of Ordnance Factories were subject to presenting a proper set of

accounts, thoroughly audited and submitted to Parliament. Also they were under pressure to show that output of the Ordnance Factories compared favourably with the private sector. If an inspection disclosed serious defects, the Secretary of State for War could dismiss any official responsible for any defective article, just as he could remove a contractor from the recommended list of contractors held by the Army Contracts Department (Hogg, 1963: 848).

The post Morley era

The reasons for the centralisation of the Ordnance Factories from 1887 onwards were partly to do with the increasing bureaucratisation of the command line and staff structure, which had first commenced after 1856 (see Chapter 3). This system of centralisation is also attributable to the earlier Cardwell reforms of the Army in general (1868-71) where the structure of command and staff level was centralised and the terms and engagement of Army service became more professional.

Also the influence of the centralisation of the contemporary railway companies between the 1850s and 1870s may have been a contributory factor. As mentioned in Chapter 2, Captain Mark Huish as general manager of what was to become the London and North Western Railway, united three separate railway companies into one centralised railway company. The scale and scope of production of the Ordnance Companies had increased since the Crimean War. The contemporary management ethos by the mid-1880s favoured centralisation of large organisations, particularly as evident from the railway industry.

These reforms continued during the early 1880s under Childers; also, the scope of weapons technology had developed and increased. Such developments were

hindered by a decentralised system as had existed since 1855. Almost all weapons components were either manufactured or tested in at least one of the Ordnance Factories. The manufacturing structures had to be cohesive and in communication in order to achieve this goal. In the contemporary private sector the structure of British industry was still mainly centred on the family firm or partnership. Certain railway companies were developing along similar lines and staff functions together with delegation, salaried management and the introduction of the modern costing and accounting concepts (Gourvish, 1980: 10) (see Chapter 1). Centralisation was not universal in British business structures at this point in history.

The main thrust of the Morley recommendations was to centralise the organisational structure of the Ordnance Factories by creating an overall Director General of Ordnance Factories. The Director General would be able to co-ordinate the policies and operations of all government factories simultaneously. This had the following advantages of utilising the concepts already begun in the individual Ordnance Factories, notably scientific management, costing and accounting, particularly stores inventory accounting. Also the experience of management skills and knowledge was more efficiently utilised.

The recommendations of the Morley Report of 1887 included the centralisation of Design, Manufacture and Accounting Clerical and Stores branches into one organisation based at Woolwich.

The centralisation of the Ordnance Factories under a Director-General tended to reflect an earlier model of a group of companies under a holding organisation.

Hogg suggested that the restructuring of the Ordnance Factories followed the Morley recommendations:

"On studying the Morley Report one cannot fail to be struck by the far-seeing nature of the reforms advocated. Although to modern ears the recommendations sound normal enough, they were in their day revolutionary ... They drove the first wedge into the bastion of military control which had dominated the factories from time immemorial." (1963: 859).

Actually Hogg is mistaken in his assessment. Military superintendents only began to be appointed into the government manufacturing departments from 1855. Despite the recommendations of Morley, and the optimism of Hogg, the Ordnance Factories remained under direct military control until May 1915. Initially Morley made no recommendation on Engelbach's recommendation for a Chief Mechanical Engineer.

The reforms when enacted during the post-Morley era did not appear so revolutionary as indicated by Hogg (1963: 859). Davenport-Hines also tends to be critical of the post-Morley reforms, particularly in those who were not implemented. Davenport-Hines suggests that Anderson was appointed from the private sector to implement the post-Morley reforms but was frustrated in these attempts due to the upsurge in the naval armaments programme. However, Anderson's obituary is more complementary:

"he made many improvements in the details of management of the Arsenal, thereby removing numerous sources of waste of money, which his experienced eye quickly detected, and there is no doubt that at the time of his death the factories were working far more economically than when he took up the post." (*Proceedings of the Institution of Civil Engineers*, vol.CXXXV, 1899: 323)

However, Davenport-Hines suggests that the first DGOF Major-General E. Maintland CB RA, appointed in 1887, was inefficient (DBB, 1984, vol.1 (A-C: 61). He was, however, an experienced superintendent of Ordnance Factories. The removal of the CSOF Sir Frederick Hay Donaldson for apparently similar reasons of inefficiency is

also suggested by Davenport-Hines. However, Donaldson was a civilian and his removal was for political reasons rather than for inefficiency. This is further pursued in the next chapter. Maintland, as a senior military officer, had originally been commissioned in December 1851 and served with distinction in the Indian Mutiny, and then as military attaché Constantinople. In terms of experience within Ordnance Factories, Maintland had previously served in the Royal Gun Factories first as an Inspector, then as Assistant Superintendent of the Royal Gun Factory 1872-1877, becoming Superintendent there from 1880 to 1887.

Regarding the duties of Director General of Ordnance Factories, Maintland was:

"charged with the administration and works as far as possible on a commercial basis of the Ordnance Factories at Woolwich, Enfield, Waltham and Birmingham. He submits estimates of the expenses necessary to carry out orders he may receive for Army, Navy, India and Colonial Services, and prepares accounts of expenditure incurred by the factories for audit in the Finance Division and submission to Parliament. He makes an Annual Report to the Secretary of State through the Finance Secretary to the War Office." (War Office Staff List, 1888: 37, PRO Library).

There is no evidence to suggest that Maintland was not up to the job and he took normal retirement in 1890. Davenport-Hines also claims that military appointed DGOFs were cheaper to employ. He compares Maintland's annual salary of £1,800 against Anderson's salary of £2,500. In his argument, Davenport-Hines suggests that the appointment of military DGOFs was more popular with the Treasury as they were cheap, but the reverse is true and Davenport-Hines had not considered that the military superintendents, DGOFs and other military staff employed in the Ordnance Factories in fact received two salaries: they received their full entitlement to a military salary, together with superannuation rights. However, their civilian salaries

for duties with the Ordnance Factories did not have superannuation rights, thus their dual salaries would make them more expensive to employ than their civilian counterparts. Davenport-Hines suggests that the apparent cheapness of military superintendents, DGOFs resulted in a military CSOF superseding Anderson (DBB, 1984, vol.1 (A-C): 6). However, Colonel Sir Edmund Bainbridge CBI was a retired Royal Artillery officer and was in effect a civilian appointee.¹

In 1890 the office of Surveyor General of Ordnance was abolished, and the duties taken over by the Financial Secretary to the War Office, a political office.

Also in 1899, a Chief Mechanical Engineer was appointed for the first time, some eleven years after it was recommended by Engelbach in evidence given to the Morley Inquiry. The first Chief Mechanical Engineer was Hay Frederick Donaldson. The role of the chief mechanical engineer had evolved from the original Deputy Director of Ordnance Factories. Donaldson had also previously been Superintendent of the Royal Small Arms Factory.

The duties of the Chief Mechanical Engineer were to:

"give[s] such advice and assistance as he may deem necessary, or may be asked for by the Chief Superintendent, or by the Superintendent of Factories, on all matters relating to the introduction, extension, improvement and maintenance of all machinery and appliances in the Ordnance Factories. He has free access to the Ordnance Factories workshops and other buildings and reports to the Chief Superintendent on the general character and output of work with special reference to speed and feed, piece-work rates, wages, quality and cost of labour, and advises generally as to the most economical methods by which the work can be carried out. He reports direct to the Chief Superintendent who, if the recommendations involve the saving or expenditure of money transmits them to the Financial Secretary through the Chief

¹ Colonel Edmund Bainbridge CB, appointed CSOF 18 February 1899. Bainbridge was a retired officer of the Royal Artillery whose previous military service had included extensive periods with Ordnance Factories including Inspector of Warlike Stores at Portsmouth and on the staff of the Royal Laboratory including as superintendent from 1892 to 1899.

Superintendent and the Director General of Ordnance." (War Office Staff List 1899: 39).

Most superintendents of Ordnance Factories from the time of the Morley Report in 1887 to 1900, remained mainly military officers. However, after the Murray Committee Report (Cd 3626: 1907), the post of Chief Mechanical Engineer and Chief Superintendent were merged. Also the number of posts of superintendents were halved as follows:-

The Royal Gun and Carriage Factories
Superintendent, Colonel C.P. Martel RA

The Royal Gunpowder and Small Arms Factories
Enfield and Birmingham
Superintendent, Lieutenant Colonel F.T. Fisher RA

This rationalisation is characteristic of the philosophy behind the Treasury sponsored Murray Committee Report. The rationality reflects cost cutting rather than cost efficiencies. For example there were closer links behind the Royal Laboratory and the Royal Gunpowder Factory than with the Small Arms factories.

Morley made no recommendation as to the piece-rate working, or the hours worked. However the major change in the post-Morley era was the reduction of the daily time of working in the Ordnance Factories except the Royal Gunpowder Factory from a 54 hour week to one of 48 hours a week in 1894, when it was sanctioned by the Secretary of State for War, Campbell-Bannerman.

In assessing the nineteenth-century reforms of the Ordnance Factories, the Morley Committee Report is an important landmark within these reforms generally. The decentralised system of the Ordnance Factories, as advocated by the earlier Monsell Reforms of 1862 and 1863, had some 25 years later become anachronistic in structure. Morley's recommendations for a centralised system and the removal of

the Ordnance Factory vote from the general Army vote in Parliamentary accounts was agreed.

However, not all of Morley's recommendations were put into effect. The superintendents of the individual Ordnance Factories were not civilianised and the political office of the Surveyor-General of Ordnance (which Morley recommended should become "the supreme controller of supply and inspection") was abolished in 1890 (Hogg, 1963: 870).

Nevertheless, the implemented reforms as advocated by Morley brought the structure and management of the Ordnance Factories together in what was then a modern production factory. The increase in artillery and ballistic science as well as weapons technology were better served by the restructured Ordnance Factories, to the benefit of the public. However, the recommendations of the Morley Report also acted as a catalyst for the industrial relations reforms of the Ordnance Factories which reflected the War Office as being in the first flight of employers.

'The First Flight of Employers' - the War Office as the model employer

In an amendment to a motion in the House of Commons on 6th March 1893

Sir John Gorst expressed the

"opinion of this House [that] no person should in Her Majesty's Naval establishments be engaged at wages insufficient for a proper maintenance, and that conditions of labour as regards hours [etc.] ... should be as such as to afford an example to private employers throughout the country." (WO 32/9275)

The Secretary of State for War, Henry Campbell-Bannerman, responded by stating that "the Government should show themselves to be amongst the best employers of the country ... [that is] in the first flight of employers" (WO 32/9275).

However, relatively unskilled labour, notably gas stokers and dockers, had been successful in attaining an eight-hour working day during the 1880s after some protracted strike action (Hobsbawm, 1979: 367). Previously, in 1872 attempts had been made to unionise gas stokers which resulted in widespread strikes, but the South Metropolitan Gas Company was the only company unaffected. The managing director, Sir George Thomas Livesy² had introduced a weekly 1s.6d good time money bonus and had abolished Sunday working during the same year (DBB, vol.3 (H to L): 813).

In March 1889 under the growth of 'new unionism', Will Thorne had founded the Gas Workers' Union, with the major objective of pursuing an eight-hour day for gas stokers, who were working a twelve-hour day. Livesy, on behalf of the South Metropolitan, agreed to the terms of the eight-hour day but only reluctantly acquiesced to double time for Sunday working. Although in respect of the South Metropolitan the terms for Sunday working were academic only, as this had been abolished seventeen years previously, though Sunday working was commonplace in the contemporary gas industry generally (DBB, vol.3 (H to L): 814).

In assessing the introduction of the eight-hour day in the Ordnance Factories in particular, and in the public sector generally, was not achieved through any threat of industrial action. Rather, it was achieved through a benevolent Liberal Government, together with the support of the management of the Ordnance Factories. The model for this may have been due to the paternalistic practices of certain Victorian entrepreneurs such as Sir George Livesy. There were economic advantages

² Sir George Livesey (1834-1908) - see DBB, vol.3 (H to L), bibliography by Francis Goodall, pp.813-17.

for an eight-hour working day, both in the public and the private sectors. Gas companies who agreed to the terms of the Gas Workers Union were persuaded to adopt a system of three eight-hour shifts in a twenty-four hour period rather than the two twelve-hour shifts then worked (Hobsbawm, 1979: 355).

But there was considerable opposition to the eight-hour working day in both the public and private sectors. In politics, the major criticisms came mainly from the Conservative benches and those who were entrenched in the prevailing classical liberal philosophy which argued that greater labour efficiency would result in higher wages earned for shorter hours worked. Therefore, the critics assumed that the cost of labour would be higher than the market could afford, thus it was assumed that in the long term this would result in redundancy and unemployment. Neither did the entrepreneur in the gas industry, nor the Victorian politician, who was guardian of the contemporary taxpayer, want to raise his costs unless he was confident of recovering them.

Therefore, much of the Parliamentary opposition to the 48-hour week for government employees also came from the Conservative benches, who moved that it would be detrimental to the public purse. It was assumed that, as in the argument against reforms in the gas industry, either more labour would have to be employed to achieve the same level of output obtained through a 54-hour week, or alternatively production would fall.

However, the overall effect of attempts to introduce an eight-hour day in the private engineering industry was less successful. The great engineering strike and lockout of 1897 was probably encouraged by the TUC and ASE due to the success of the unskilled New Unionism representing dockers and stokers, and the Liberal

Government's policy of introducing an eight-hour day into the public sector.

The critics were proved wrong: the overall results showed that:

"the aggregate changes achieved were in fact small, and indeed negligible when compared with the major periods of adjustment. Hence the Board of Trade reported in 1901, that 'the total effect of all the changes during the eight years (1893-1900), if spread over the whole working population, is quite insignificant, amounting to less than ten minutes per head per week'." (Board of Trade, *Reports on Changes in Rates of Wages and Hours of Labour*, BPP, 1900, vol.LXXII; Bienefeld, 1972: 150-151)

The introduction of a 48 hour week into the Ordnance Factories in 1894 was at the latter part of the Great Depression. Hobsbawm considers the era of the Great Depression, and the changes in the pattern of work and working hours as "the beginning of the substitution of rational for empirical 'intensive' utilisation, or of scientific management" (1979: 356).

However, Campbell-Bannerman was also quick to establish that although the Government wished to reflect the principle of a model employer which could be emulated in the private sector, in his opinion "we do not take it to mean they [the Government] should embark in new experiments far ahead of general practice" (WO 32/9275).

Campbell-Bannerman's statement laid the foundation for a 48-hour working week in most central and local government departments. This included most of the Ordnance Factories where a 48-hour working week was introduced during the early part of 1894. The exception was the Royal Gunpowder Factory, which, "owing to the dangerous nature of the operations or in the care required, it is undesirable to increase the hourly output" (SUPP 5/126 2836; BPP, 1896, vol.LXXX, Pt.1, p.ixx).

The introduction of the 48 hour week into the Ordnance Factories is contemporaneous with the ASE argument for an eight-hour day in the private

engineering industry. Indeed, reflecting in 1999 on the transition within the working structures in the Ordnance Factories from 1894, and the deteriorating labour relations in the private engineering industry, one is struck by the similarities which span one hundred years. In April 1998 it was announced that proposals will commence to transpose into U.K. law, the European Union working time directive, to come into force by October 1998. Part of this Directive states that workers need not work more than a 48 hour week averaged over four to twelve months (*The Financial Times*, 9 April 1998).

However, the earlier transition of the Ordnance Factories from 1858, including management control of labour utilisation, was promoted by the restrictions placed upon them, particularly through Treasury control. Yet it is worth reiterating the argument that the Ordnance Factories did not trade in a free capitalist market. They could only operate in a restricted market. But this market was not protected, as ordnance procurement was contracted under the two-thirds rule. Again the Treasury consideration towards the Victorian Army and Navy expenditure were not generous, neither would the Treasury be over-generous in application of extra public funding to either the Admiralty or the War Office.

Therefore the Ordnance Factories operated under a fairly harsh environment with limiting and finite resources. In order to achieve their objectives, given the restrictions as outlined, the criteria of management and efficiency developed more rapidly than it did in the private sector.

The eight-hour day in the private engineering industry

The growing demands for an eight-hour day in the private engineering industry

were symptomatic of deeper causes, notably the machine question. Many engineering industries and workshops during the 1890s reflected a craft orientated system governed and controlled by skilled craftsmen, inflexible to change.

Originally the role of a millwright practically encompassed the function of an engineer, in all its parameters. However by the mid-nineteenth century other skilled labour had been accepted into a closer bond by the traditional millwrights, who allowed the 'lesser fellows' to join their union, the ASE.

Such skills included fitters (or as they were contemporarily known by, filers). Other skilled workers who emerged from the mid-nineteenth century onwards, included turners and blacksmiths. From 1850 onwards, Britain began to lose its pre-eminence as, 'the Workshop of the World', and during the following decades witnessed recurrent unemployment in the engineering industry as a whole. The years between 1860 and 1870 were particularly severe when the margin of unemployment in the engineering industry was 16 per cent. From 1880 to 1890, this margin had increased to 26 per cent (Burnham and Hoskins, 1943; Clarke, 1957).

By the 1890s, the management and employers of the private engineering industry were concerned about labour utilisation. Interchangeability was being introduced into many companies for the first time, and the Hasley system of premium bonus systems was being introduced by numerous engineering companies in Britain (Hunt, 1951: 79). The growing crisis in industrial relations in the private engineering industry reflected more about "the principle of freedom of employers in the management of works" than the symptom of an eight-hour day, as argued by the ASE (Clarke, 1957: 130).

A number of engineering employers had formed the Federation of Engineering

Association, later changed to the Engineering and Allied Employers' National Federation (Clarke, 1957: 130). This Employers' Federation was part of a:

"sense of industrial concentration which helped to teach labour that the 'industry' rather than the 'master', singly or in small or local groups was the force which confronted it in industrial warfare." (Hobsbawm, 1979: 220)

Again the Employers' Association grew in the era of the Great Depression, as did the concept for the right of employers to manage. Other employers' associations formed in this period included the Shipping Federation.

The engineering employers were becoming more and more frustrated over the hostility shown by ASE members, in allowing piece-working to be introduced. Many local ASE district branches placed limitations on such schemes, and would fine members who worked above a locally ASE set rate. Within the private engineering industry piece-rate fixing was complicated due to differing local rates reflecting regional patterns. The transition of the industry itself had altered the character of the traditional divisions of labour. Employers were engaging unskilled hands, who could be trained as productive machine operatives in a matter of weeks. This was often achieved very effectively and cheaply through the 'sit by Nellie' system. There is evidence to suggest that many 'unskilled' machine operatives produced output of better quality and quantity than a skilled (craft orientated) operative. The ASE insisted that only skilled craftsmen, at craftsmen rates, should be employed as operatives despite the 'deskilling' process (Clarke, 1957: 131).

However, despite the ASE protestations, the Engineers "followed the machine" (Hinton, 1973: 61). Hinton points out that by 1914:

"a substantial proportion of the work performed by craftsmen at the craft rate required little of their skill", a measure of how far the engineers had succeeded in 'following the machine'... The ASE

defence of the standard rate rested increasingly on bluff." (Hinton, 1973: 61)

The reason in part for craft engineers 'following the machine' in the view of Cole was the spread of piecework. Craftsmen were attracted to less skilled work through the incentive of earning what, in many cases, was well above the ASE district set rate for piecework for repetition production (Cole, 1923: 165-6). This was probably more inflationary than an incorrectly set piece rate.

Rate-fixing was normally arrived at between the management and the individual engineering worker. Clarke suggests that rate-fixing at this time (during the 1890s) was in its infancy, and suggests that the piece-working system was often abused (1957: 132). Whilst not disputing this, both rate-fixing and piece-working were at an advanced stage as experienced in the Ordnance Factories. No system of abuse was admitted to the Morley Committee of Inquiry of 1887 (C 5116), particularly in relation to the evidence given by James McGee, manager of the Enfield Rifle Factory, as stated in the previous chapter.

Cole, writing in the post-1918 era, stated that:

"In most branches of the British engineering and kindred industries, and particularly in those in which the skilled workers are mainly engaged, the position was before the war, and still to a very great extent remains, essentially different. Piece-work and other forms of payment have not been introduced into these industries under national agreements between the big trade unions and employers' associations... Where they have been introduced, it has been shop by shop, and often job by job, and without any collective trade union regulation beyond the insistence that the district standard time-rate of wages shall be paid to every skilled worker engaged under a system of 'payment by results', irrespective of his output." (1922: 12-13)

Indeed, Cole admits that:

"The introduction of payment by results, in any or all of its forms, has been made, as a rule, in the face of more or less definite opposition from the engineering trade unions. It was one of the principal issues

in the great national engineering lock-out of 1897." (1922: 13)

Equally, the era of the Great Depression "produced a national and international socialist movement, which inevitably provided many of the most intelligent and dynamic leaders of the new unions" (Hobsbawm, 1979: 221).

Though not a new union, the ASE replaced its otherwise conciliatory general secretary in 1896, with George Barnes, a militant, in the mould of Tom Mann and John Burns, who were also associates of Barnes. The attitude of Barnes and the ASE was to preserve the status quo of craft skills and labour demarcation. This was despite the growing competition from Germany and America.

The eventual conflict in the private engineering industry came in 1897, in the guise of a claim from the London Branch of the ASE for an eight-hour day, or 48 hour week to replace the existing nine hour day or 54 hour week. The engineering dispute was neither popular with the press or public, and a plethora of correspondence was published in *The Times* between 1897 and 1898. This correspondence was generally critical or hostile to the ASE and its leadership, which would be expected in *The Times*.

One letter, the author of which describes himself as "an Old Trade Unionist of Many Years", refers to what may have been the crucial grievance of the ASE, by suggesting that there was a curtain containing the eight-hour argument concealing the major question in the dispute, that being the 'machine question'. He suggested a compromise. The engineering employers agreeing to an eight-hour day or 48 hour week, and the ASE in agreeing the withdrawal of their restrictions on the use of machinery (*The Times*, 7 September 1897). This was the model of the working arrangements at most of the Ordnance Factories, and the anonymous writer to *The*

Times may have gained the idea for his argument from the practice conducted at the Royal Arsenal, Woolwich.

The focus of correspondence to *The Times* commented on the use of machinery in America where

"the introduction of labour saving machinery [facilitates] its economical working and ... so far from the use of such machinery decreasing the demand for labour and lowering the rate of wages, the contrary effect." (*The Times*, 7 September 1897)

Little mention was made of the Ordnance Factories, in the contemporary press. Also subsequent historians of the dispute have made no significant comparison between the private sector engineering industry and the public sector Ordnance Factories. Cole only gives the briefest mention of the Royal Arsenal at Woolwich (Cole, 1922: 18 and 84). Clarke again only referred to the Ordnance Factories and the eight-hour day briefly in his paper, suggesting that only "a handful of firms had adopted the 8-hour day, and in 1893 it was introduced in certain Government workshops" (1957: 132).

However, the General Secretary of the ASE, George Barnes in a letter to *The Times* compared and contrasted "the Speed and Feed" men at the Elswick Company with Woolwich Arsenal, as follows:

"What we protest against is the wretched espionage which degrades both the worker and the watcher and while by doing so defeats its object. At Woolwich Arsenal better work and more of it is turned out with speed and feed men, and everywhere output is increased rather than diminished in proportion as men are treated with consideration. The fact is that the Elswick Company have started a system, and are seeking to extend its application, which is based on the notion that workmen are rogues and cheats, and we believe that such a system is bound to fail in the long run ..." (*The Times*, 9 September 1897)

Barnes may have been incorrect in his assessment of the Royal Arsenal, Woolwich and the absence of speed and feed. On the appointment of a chief mechanical

engineer in 1898, one of his duties was to oversee the Ordnance Factories "with special reference to speed and feed, piece-work rates, wages, quality and cost of labour" (War Office Staff List, 1898: 37).

The comparison made by Barnes is important in that it reflects the management styles at the Elswick Company and at the Royal Arsenal, Woolwich. Indeed, it tends to equate with McGregor's concept of Theory X and Theory Y. The idea that concepts of Theory X and Theory Y existed in industry before McGregor is apparent. McGregor may have only isolated an existing management practice which had existed for decades. This is similar to the principles of the development of scientific management, referred to in the previous chapter, which Urwick and Brech (1953, vol.2: 8-9) and Hobsbawm (1979: 355-362) had argued existed long before Taylor.

The Ordnance Factories and the forty-eight-hour week

The introduction of a 48 hour week at the Ordnance Factories was a reflection of patterns of rational intensive utilisation through elements of scientific management which had previously been conducted at the Ordnance Factories.

The implementation of the 48 hour week was phased into the Ordnance Factories from early 1894. The Accountant General, W.H. White in a hand-written memorandum implemented the scheme where "the Secretary of State has approved the adoption of a normal working week of forty-eight hours, in the Ordnance Factories where it is found practicable to adopt it" (SUPP 5/126).

Where there were reductions in hours, normally to an eight-hour day during the 1890s, it was enforced through government intervention, rather than by either

industry or the trades unions. Bienefeld states that:

"large number of reductions agreed to by the authorities determining the hours of various groups of government employees, including 43,000 who were granted an eight-hour day in 1894." (1972: 152)

The Board of Trade Report for 1896 identifies these employees as follows:

"Of the total of 43,895 Government employees whose hours were shortened, 43,039 had their hours reduced to 48 hours per week:

Occupation	Number of reductions	Number of persons whose hours of labour were reduced	Corresponding number for 1893
Government employees	14	43,895	134
Police	3	117	602
Employees of local authorities	27	2,301	910
Totals	27	46,313	1,646

(BPP, 1896: vol.LXXX, Pt.1, p.ixv)

The Government Employee figure was broken down as follows:-

"The following table classifies the 43,895 workpeople in government employment whose hours of labour were reduced among the various Government Departments.

Department	Number of workpeople whose hours of labour were reduced	Average number of hours reduced per week
Admiralty	24,263	2.49
War Office	18,977	5.79
Post Office	518	9.50
Other departments	137	4.81
Total and averages	43,895	4.00

(BPP, 1896, vol.LXXX, Pt.1, p.ixv)

Other workers were also given the eight-hour day, through statutory legislation, notably textile workers under the Textile Act 1902.

Most of the Ordnance Factories in the last decade in the nineteenth century were located in the greater London area. The introduction of an average eight-hour day into the Ordnance Factories in 1894, when compared with the contemporary private engineering industry within the London area reflects marked contrasts. The Board of Trade Report comments on this:-

"Engineering and Machinery Works, District XII, London:

... the hours of labour were generally 54 per week, but in a few works the hours were more. Stationary engineers, warehouse hands, store-keepers, timekeepers, watchmen and carters usually worked longer hours than other employees." (BPP, 1893, LXXXIII)

Campbell-Bannerman's decision to introduce an average eight-hour day or 48 hour week was only part of an overall policy of government to introduce a shorter working day into numerous government departments.

The reasons for the 48-hour week at the Ordnance Factories were due to a number of factors. In assessing these reforms, one must be aware of the contemporary reforms in the public sector generally. The overall reforms may have been as a response to the prevailing labour problems faced in the private sector and with the growth of the rise of New Unionism. However, Campbell-Bannerman was also aware of the emerging crisis within the engineering industry and the growing militancy of the ASE.

A large percentage of the Ordnance Factories workforce were skilled workers to varying degrees and many belonged to the ASE. Union membership by 1894 was tacitly accepted by the War Office (see McGee's evidence to Morley, 1887 (C 5116),

question 7738: 378). By allowing a 48-hour week in the Ordnance Factories, Campbell-Bannerman split the ASE in the London area. This was similar to Livesy's policy by restructuring the working day into system of three eight-hour shifts at the South Metropolitan Gas Company. The company was not directly affected by the gas strikes elsewhere in London.

Other engineering companies also allowed an eight-hour day, profit sharing schemes and bonus systems equal to those experienced in the Ordnance Factories. Jeremy states that "between 1865 and 1912 a total of 199 profit-sharing schemes were started" (Jeremy, 1998: 449). Certain railway companies along with food, confectionery and beverage manufacturers based their employment systems on a paternalistic structure. This tended to be the case if the company founders / directors belonged to certain religious groups such as the Quakers, and the experiences of the Fry and Cadbury companies are an example of this; alternatively, where the industry dominated a town, as for example railway engineering and towns such as Crewe and Swindon.

In terms of Swindon and the Great Western Railway (GWR), the town had been selected in 1841 by Brunel junior as the site for the company's central repair depot. The GWR built a model village, a church, chapel, shopping centre, gardens and a cricket ground for its employees. Again, mindful of improving the technical expertise of present and future employees, the company built a hall and library for the Mechanics Institute, where educational, literary, musical and other social pursuits were held. The GWR was influential in the politics of Swindon, including the School Board, Water Board and technical education. Two chief mechanical engineers of the GWR, Dean and Churchward, were very influential in the development of technical

education in Swindon.

Both Swindon and Woolwich are examples of one-industry towns. The Royal Arsenal had the same effect on the politics of Woolwich, together with the Mechanics Institute, church and, until 1904, the Royal Arsenal had its own elementary school for the children of its workers. A town's reliance on one industry survived or declined according to the industry's fortunes. Ashworth (1969) noted this with a naval dockyard town such as Portsmouth, and Williams (reprinted 1984) with Swindon. In 1907 there were provisional plans to remove the Royal Arsenal to the Midlands. The people and politicians of Woolwich led a campaign to prevent this. A committee was established, chaired by Arthur Henderson, to assess the effects such a move would have on the economics of the Woolwich area and the plans were eventually abandoned.

Other benefits including sick pay existed in numerous industries during the 1880s. Sick pay was administered through sick clubs, through which employers and workers contributed (Jeremy, 1998: 452). Similar schemes also existed in the Ordnance Factories at an earlier period (in the 1850s). McGee explained to the Morley Inquiry that a sick pay scheme existed at the Enfield Rifle Factory whereby the workers contributed a penny a week to a sick fund (Morley, 1887 (C 5116), questions 7704 and 7706: 377).

. Also seasonal variations played a crucial part in the transition from a 54 hour to a 48 hour week.

There is a signed collective document from the Forgers Branch at the Royal Carriage Department addressed to the Superintendent who in their application:

"... of the undersigned of the Forgers Branch RCD respectfully beg that you will take the following into your kind consideration in respect to the working of 48 hours per week. Ordnance Factories, Viz: That we should be allowed to commence work at 6am during that period of the year in which no artificial light would be required; and that during the remaining period work should commence at 8am. We would urge in respect to the commencing of at 6am, that we should be able to be working at a time when the heat of the sun would not be so oppressive, and to men who have to contend against the heat of large fires, and furnaces, as well as that of the sun, this would indeed be a great boon. We would also respectfully ask, that the dinner hour should in no case be altered from the present system. Trusting that you will take the above into favourable consideration, we beg Sir, to remain Your Obedient Servants." (SUPP 5/126)

This petition is undated, but is signed by one hundred forgers at the RCD, in five columns of twenty names each. No one person identifies themselves as a spokesperson, and the names are not in alphabetical order.

This petition obviously did not instigate the 48 hour week, but it probably accelerated policy already under consideration. The later start meant the first shifts began work in light and work stopped just before twilight. British summer time did not exist in 1894, but was temporarily introduced as a war-time policy during the First World War. The major reason for these radical changes were concerned with efficiency and economic performance, and this is a major example of the 'intensive utilisation' policy designed at co-ordinating greater output. In terms of labour relations, the overall policy of the 48 hour week is also concerned with costings, and the two elements combined relate very much to scientific management.

The change to a 48 hour working week also established a more efficient method of labour utilisation and quality of production. This was more noticeable at the Royal Arsenal at Woolwich. Prior to the changeover to an eight-hour day the majority of piece-working at the Ordnance Factories was on a premium piece-rate method, similar to the Hasley system. This was because there was a breakfast break

of one hour, some two hours after the start of the working day.

The hours of work under the original system of 54 hours a week was as follows:

Old hours	Monday to Thursday	Friday	Saturday	Total per week
Morning	6 to 8	6 to 8	6 to 8	54 hours
	9 to 1	9 to 1	9 to 1	
Afternoon	2 to 5.30	2 to 6	--	
Total hours per day	9½	10	6	

(BPP, 1896, LXXX, Pt.1, p.ixx)

The breakfast break of one hour, allowed two hours after the commencement of the working day was not efficient in terms of labour utilisation, energy, machine working, fuel and lubrication. Also local custom at the Royal Arsenal saw many workers frequent public houses during the breakfast hour. Campbell-Bannerman defended the introduction of the eight-hour day which in the short-term would reflect on increase of expenditure in wages, but in the longer term would accrue savings, particularly in fuel, light, lubricants and general wear and tear through "the increased energy of the workmen, and lastly by the prevention of lost time owing to the suppression of the breakfast hour (hear, hear)" (*The Times*, 4 May 1894).

There is no direct evidence to suggest that a drink problem existed at the Royal Arsenal before 1894 although the potential for a problem may have been apparent. Campbell-Bannerman probably repressed this potential problem, which could have affected production and efficient output, very successfully through the introduction of an eight-hour day. Also, the restructured 48-hour week reduced the

stress and fatigue of the labour force. The elimination of an idle hour and less fatigue resulted in fewer rejections at the inspection stage in the factories by the viewers.

The work of analysing and tabulating the rates of wages paid to workers in the Ordnance Factories was begun in 1892. By May 1893, this research was at a well-advanced stage. The Financial Secretary, in answer to a Parliamentary question, confirmed that no specific minimum wage rate had ever been accepted by the Government (*The Times*, 25 April 1893). The Financial Secretary was Mr. W. Woodall who, in 1887, had been Deputy Chair of the Morley Committee.

There were numerous objections made in Parliament to the introduction of a 48 hour week at the Ordnance Factories, particularly from the Conservative benches. They held similar views previously aired by the management of the contemporary British gas industry as outlined previously. By May 1894, Woodall confirmed to Parliament that the 48 hour week had been satisfactorily introduced at the Royal Gun Factories, and the Royal Laboratory. The forty-eight-hour week had included all but three hundred men at the Royal Arsenal, Woolwich. These three hundred men were employed on continuous operations. But these three hundred men only represented just over two per cent at Woolwich (*The Times*, 4 May 1894).

Woodall also confirmed that the new 48 hour week had been introduced with the full cooperation of all concerned, despite considerable operational upheaval of the individual departments concerned. However Woodall expresses his disappointment that overall, the War Office did "not at present see its way to apply the eight-hour schedule to departments which worked under continuous operations of a twelve hour schedule" (*The Times*, 4 May 1894).

The imposition of an average eight-hour day was made on workers paid through piece-work, nor had the price of piece-work been reduced "since the hours of labours had been reduced" (*The Times*, 4 May 1894). This statement made by Woodall was an attempt to allay Conservative fears that the eight-hour day would reduce productivity whilst simultaneously increasing workers wages. The protagonists argued that for the same output more would have to be employed. The reforms of the working hours at the Ordnance Factories actually increased the quality of output whilst stabilising the wages bill.

Defending his junior minister, Campbell-Bannerman reiterated that he did not anticipate that "any additional workmen will be required as a result of reducing the working hours to forty-eight hours a week" (*The Times*, 4 May 1894).

The new hours at Woolwich came into force on 26th February 1894. These were as follows and reflected 11,790 workers.

New hours	Monday to Thursday	Friday	Saturday	Total hours per week
Morning	8 to 1	8 to 1	8 to 12.40	
Afternoon	2 to 5.40	2 to 5.40		
Total hours per day	8½	8½	4½	48 Hours

(BPP, 1896, vol.LXXX, Pt.1, p.ixx; supp. 5/126 42863)

The 48 hour week was also extended to the Inspection Department at the Royal Arsenal, Woolwich, which affected 701 employees. Here the new operational hours were phased in from 26 February 1894 for the majority of the employees, and completed for the whole Department by 12 March 1894.

Old hours	Monday to Thursday	Friday	Saturday	Total hours per week
Morning	6 to 8	6 to 8	6 to 8	
	9 to 1	9 to 1	9 to 1	
Afternoon	2 to 5.30	2 to 6		
Total hours per day	9½	10	6	54 Hours

New hours	Monday to Thursday	Friday	Saturday	Total hours per week
Morning	8 to 1	8 to 1	8 to 12.40	
Afternoon	2 to 5.40	2 to 5.40		
Total hours per pay	8¾	8¾	4¾	48 hours

(BPP, 1896, vol.LXXX, Pt.1, p.ixx)

There were certain categories of employees who were not included in the 48 hour a week scheme, at the Royal Arsenal, Woolwich:

"To these hours, the necessary exceptions will be made in some cases such as stokers where their duty has always hitherto required a more prolonged attendance than the 54 hours, and also in such Factories where the hours of work are governed by the seasons (in particular the Royal Laboratory), and are not absolutely the same all the year round, or in which owing to the dangerous nature of the operations, or in the care required, it is undesirable to increase the hourly output" (this refers mainly to the Royal Gunpowder Factory). (SUPP 5/126 42836; BPP (1896) vol.LXXX, Pt.1, p.ixx)

The evidence of stokers employed at the Royal Arsenal from the 48-hour week seems somewhat unusual, given that the crucible of the 48-hour week was the gas stokers strike and the earlier changes in working conditions by Livesy at the South Metropolitan Gas Company. The eight-hour day had been introduced by operating

a system of three eight-hour shifts. There is no explanation as to why a similar system could not have been introduced into the Royal Arsenal, particularly the Royal Laboratory.

However, J.A.C. Hay, who had designed the Royal Small Arms Factory at Enfield and the Royal Gun Factory, also designed and constructed two gas works, one which supplied the Royal Arsenal, the Royal Artillery Barracks and the Military Hospital at Woolwich, and the second which supplied the Royal Military College at Sandhurst. Part of his duties as Inspector of Machinery at the Royal Arsenal was also superintendent of the gas works at Woolwich Arsenal. In evidence to the Morley Committee, Hay admitted that the South Metropolitan Gas Company, which supplied the Borough of Woolwich, made gas at 1s.1½d per 1,000 cubic feet, compared to 1s.9d at the Arsenal gas works. Hay stated that although the South Metropolitan Gas Company manufactured ten times as much gas, he considered that the Arsenal gas works did not compare unfavourably with it. Part of the Arsenal's problem was the length of the mains laid to supply the Royal Herbert Military Hospital on Shooter's Hill Road. This was two miles from the Arsenal site and up an incline. According to Hay, this was a major factor in the higher price differential between the Arsenal gas works prices and that supplied by the South Metropolitan Gas Company. Hay refuted that the quality of gas as supplied in the Arsenal's gas works was equal to that supplied by the South Metropolitan, despite earlier evidence to the contrary given by General Close.

Hay, in evidence to Morley, commented that up to two years previously the coal supplied was of inferior quality and insufficient sizes of the gas mains both having caused low gas pressure. By 1887, however, Hay admitted that the inferior

coal supply had been rectified and he was personally responsible for the quality control of the coal supplied for the manufacture of gas. The gas mains were still a problem, however. Applications had been made to enlarge the gas mains but, at the time of the Morley Inquiry, Parliamentary approval was still awaited (Morley, 1887 (C 5116), questions 4007 to 4146, summary of evidence: 27-28).

In terms of efficiency and in the interests of the public, the War Office via the Morley Report could have considered privatising the supply of gas to Woolwich Garrison to the South Metropolitan Gas Company, thus making considerable saving to the public. No such recommendation was made, however.

At Enfield, the number of employees affected was 1,800 and the new hours came into operation on 26 February 1894. The change of hours at the Sparkbrook Rifle Factory, Birmingham, including the Inspection Department at Bagot Street, Birmingham, were identical to the new hours at the Royal Arsenal, Woolwich, rather than at Enfield. However, on representation from the Superintendent of the Birmingham Rifle Factory, the hours were immediately changed to equate with Enfield. *The Times* reported that, "in deference to the strong representation of the Superintendent of the Sparkbrook Factory", the Financial Secretary "altered the hours of work at Birmingham to agree with those of Enfield instead of Woolwich" (*The Times*, 8 March 1894).

The new changes did not affect the Royal Gunpowder Factory at Waltham Abbey. This complex included the cannon, cartridge and rocket factories. The 54-hour week remained, due to the dangerous of the production process and the care required in successfully operating an explosives factory. Indeed, the 54-hour week included both day and night shifts, the shell forges, and the shell and brass foundries,

and in most of the smithery (SUPP 5/126 'Reasons for Excepting the Royal Gunpowder Factory from the Eight-Hour Day').

Despite this the Manager of the Cordite Factory at Waltham Abbey, James M. Thompson, submitted a paper to the Superintendent arguing for a two shift system at the Cordite Factory rather than the three shift system. This would, in effect, reduce the working week for the Cordite Factory only, from a 54 hour week to a 49 hour week.

Thompson argued that the advantages of a two shift system would have the accompanying advantages:-

- "1. No electric light required after 11pm
2. A saving of steam power
3. Saving in wear and tear of shafting and machinery and in oil for some
4. When No.2 Guncotton stove is ready, the no. of men taken on will be reduced by about 10.

I would propose that all on shifts work Monday, Tuesday, Wednesday, Thursday and Friday from 6am to 3pm and 2pm to 11pm, and on Saturday 6am to 10 am and 9am to 1pm = 49 hours per week." (Supp. 5.431)

This scheme was approved by the Accountant General on 5 October 1893, and came into force some weeks prior to the 48 hour week in the remaining Ordnance Factories. This memorandum by the manager of the Cordite Factory shows the professionalism of the factory managers, as previously demonstrated in the Morley Report.

Hourly-paid workers and clerical staff

However in all cases where the men were paid on daily or hourly rates, it was policy after the introduction of the eight-hour day, that no worker would receive a

lesser amount of money for working 48 hours than he did for working 54 hours. Therefore for this type of worker, the introduction of a 48 hour working week meant in effect that he received a pay increase of one eighth of the "present hourly ratings at which the men are entered on the books" (SUPP 5/126 42836). The daywork rating used in the calculation of holiday pay, sick and injury pay, superannuation, and non-effective allowance of persons employed on piece-work was similarly raised, "so as to give the same rate of pay for a 48 hour week as would hitherto have been issued for a week of 54 hours" (SUPP 5/126 42836).

There appeared to have been a change since Monsell 1863, and Morley of 1887 which confirmed that industrial workers in the Ordnance Factories were not superannuated, as they received the full market price for their labour. However in relation to piece-work prices, no increase was made in these as a consequence of the reduced hours of working.

Regarding the hours for clerical writers who were paid from the Wages Vote, they were now paid for 42 hours a week, instead of the original 45 hours, made up as follows:-

Monday to Friday	-	9am to 1pm and 2pm to 5.30pm
Saturday	-	9am to 1pm

Any overtime attendance given by these writers did not count for extra time payment until the normal Factory hours had been worked.

The pay for workers and writers was also allowed if any of the Ordnance Factories were closed for any period. The time lost no longer had to be worked-up. Pay was issued as for free holidays. This condition did not apply to writers, assistant foremen, foremen and those of higher rank.

Overtime

Overtime for each of the first two hours in any one day was calculated as an hour and a quarter. Every additional hour work thereafter was calculated as an hour and a half. However extra time was not counted until the total weekly number of ordinary hours had been made up (SUPP 5/126). these conditions and the eight-hour day were officially introduced in February 1894.

The concept of Theory Y management is also apparent from the first call time check of the men coming to work. They had to deposit their metal ticket into the appropriate box placed close to where they worked. From 1894, a second call was made two hours after the first call, "so that men late for the first call would have a second chance" (Supp. 5/126 42836). This applied to mornings only. No second check was allowed in the afternoon.

Some workers at the Royal Arsenal worked in outlying shops. They were taken to and from their work by the military railway from near Plumstead Gate. Their check tickets were collected as they entered the train, when their paid day began. During the return journey from work the trains began before the end of work and the men deposited their tickets at Plumstead Gate on the termination of their journey (SUPP 5/126).

The introduction of the 48 hour week at the Ordnance Factories and the standardisation of overtime procedure, resolved the previous concerns expressed by Hurst to the Morley Committee some eight years previously.

The transition of a 48 hour week from an original 54 hour week also included the Royal Army Clothing Department, which affected 535 men and 84 women workers, and the Ordnance Stores Department at Woolwich. This affected 696 men

and 27 women workers.

The 48-hour week was successfully operated in the Ordnance Factories for twenty years. However, the onset of the First World War in August 1914 obviously radically transformed the working structure there.

Industrial relations at the Royal Arsenal Woolwich - the legacy of the nineteenth century

Women were employed from time to time within the Royal Arsenal and the Ordnance Stores Depot since 1855. They were mainly employed in the paper factory making cartridges or employed in shell filling within the Royal Laboratory. The nature of this work was the major role of women workers employed at the Royal Arsenal during the First World War. Although women workers were not a permanent feature of the regular workforce at the Ordnance Factories before 1914, women workers were regularly employed at the Ordnance Stores Depot on the Arsenal site at Woolwich and its sub-depot at Woolwich Dockyard. Evidence from the 1907 Murray Committee (Cd 3626) suggests that a few women were also employed at the Royal Laboratory. However, Murray did not quantify the number of women employed. This is despite the suggestion in the official history of the Ministry of Munitions, that "the use of female labour at the Arsenal had been stopped ... many years before" (*History of Ministry of Munitions*, 1922, Part 1, p.14).

Although the Murray Committee did not attempt to quantify the actual numbers of women employed at the Royal Laboratory, nor describe the work they undertook, it is assumed that they were employed in shell filling "with a considerable number of boys" (Murray, Cd 3626, 1907, para.6).

It is not the purpose of this thesis to examine in depth industrial relations at the Royal Arsenal Woolwich during the period of the First World War, two broad points have been identified by Hinton (1973) concerning industrial relations at the Royal Arsenal between 1915 and 1918. These are:

- Women and 'dilution' were successfully deployed into the labour force at Woolwich from 1915; and
- The lack of industrial militancy with the Woolwich trade unions, particularly the ASE from 1914 to 1918, compared with the contemporary private sector.

Hinton has not recognised two prevailing characteristics about the nineteenth-century legacy of industrial relations at the Royal Arsenal. This legacy was the reason for the easy transition of women workers and the rather less militancy displayed by the ASE at Woolwich during the First World War period.

By May 1917 one third of the total workforce at the Royal Arsenal were women (this represented between 25,000 to 26,000 women workers out of a total workforce of 74,467). Most of the dilution took place in the Royal Laboratory. This was the traditional area of women workers. The work itself involved shell filling and cartridge manufacture. The *History of the Ministry of Munitions* suggests that fewer women were employed at the Gun and Carriage Departments as "being less suited to women" (*History of the Ministry of Munitions*, vol.VIII, Part II, Ch.1, p.16). In 1917 about 1,150 women were employed in the Gun Factory, representing 30% of the total workforce. However, according to Hinton only 0.4% of the workers in the Carriage Department were women (1973: 179).

The official history of the Ministry of Munitions suggests that the smoothness of the dilution of labour at the Royal Arsenal Woolwich was because of the excellent

relationships in labour relations at the Arsenal. Hinton has suggested that this was due to the acceptance of the shop stewards' committee at Woolwich.

"The smoothness with which dilution was introduced probably reflects the fact that already, before the war, the skilled workers had built up a shop stewards' committee and gained recognition for it." (Hinton, 1973: 180)

This, however, may not be the principal reason for the smoothness of the dilution process at Woolwich. The Royal Arsenal had a culture of accepting women workers since the nineteenth century. It probably was this factor which affected the Woolwich Shop Stewards' Committee and allowed the smooth transition of women workers into the Royal Arsenal in 1915.

The second point concerns the concept of interchangeability. Interchangeability, craft dilution and the principles of scientific management were also part of the culture of the Ordnance Factories having been introduced and developed since the mid-nineteenth century, whereas in 1914 the contemporary private engineering industry was still coming to terms with them. Hinton explained that the "apostles of scientific management had long claimed that modern engineering production could dispense with them" (1973: 97-98).

This had already been achieved in the Ordnance Factories, particularly at Enfield and Woolwich where the craft skills had been reduced. In the private sector Hinton explained that "new jigs attached to lathes, and other machines, turned skilled work into almost foolproof machine minding ... speed and feed tables replaced the experienced judgement of craftsmen" (Hinton, 1973: 98).

The transition of Enfield and Woolwich into factory-orientated engineering units also had an effect on the development, acceptance and recognition of trade union membership and attitude. Earlier, evidence given by James McGee to the acceptance

of trade union members at Enfield without recognition rights was stated. At the time McGee was giving evidence to the Morley Inquiry of 1886-87. McGee's testimony suggested that the War Office tacit acceptance of trade union members without conceding to bargaining or recognition rights had moved considerably since the mid nineteenth century. Both the Molesworth Committee (1855) and the first Monsell Committee (1862) tended to reflect some hostility to trade union membership.

By the time of the Morley Inquiry, trade union membership was accepted by the War Office although trade unions were not recognised for bargaining purposes. As stated earlier in this chapter, McGee had stated to the Morley Committee that no worker was prejudiced in respect of trade union membership (Morley, 1887 (C 5116), question 7738: 378).

Acceptance did not necessarily mean recognition for bargaining purposes. However, in March 1906 H.F. Donaldson (the Chief Superintendent of Ordnance Factories) wrote to the Secretary of State for War in order to clarify points raised at a previous meeting. Haldane's reply clarified two principles which were previously agreed:

- "(1) that men or trade union officials on their behalf should be able to come and discuss matters affecting a class with me, or with an informal advisory committee here, and
- (2) that on these matters and on individual cases men or trade union officials should have access to you or to the Superintendents as is most convenient, whether the officials of the unions are actually employed in the factories or not, and whether or not the men concerned are actual members of the unions."

It was also confirmed by Haldane that "we could not accept the claim that when once a union had taken up a case there was to be no further communication between the managers and men" (WO 32/7051 - letter by Haldane, 9 March 1906, to H.F.

Donaldson CSOF).

In matters of recognition, dialogue and acceptance of trade unions, the Ordnance Factories did reflect a model employer ethos whilst accepting the current market rate for labour on a regional basis. Many private sector organisations paid well below what was deemed to be the current market rate for labour and did not allow trade union representation nor an eight-hour working day. These factors tended to be the cause of the industrial unrest of 1911/12 in the private sector.

The almost tacit recognition of trade unions within the Ordnance Factories eventually led to the creation of the first Shop Stewards' Committee at the Royal Arsenal, which was recognised by the Army Council at the War Office in November 1912. Cole stated that:

"Probably the most powerful pre-war (1914) works organisation of trade unions and the most fully recognised in practice by the trade unions to which the members belonged, was the Royal Arsenal Shop Stewards Committee at Woolwich... This, however, was recognised as an exceptional case, and had little influence on the position elsewhere." (1922: 18)

The founder of the Royal Arsenal Shop Stewards' Committee was Tom Rees, a fitter. By 1914 Rees had been elected as full-time London District Secretary of the ASE. Rees was influential in developing the shop steward system under District Committee control throughout London District. This Committee was representative of the skilled engineers within the Arsenal site (Hinton, 1973: 180). Five years later, in July 1917, there were between 110 and 130 shop stewards from the various departments on the Royal Arsenal site, which regularly met together monthly. The Committee elected an Executive of seven members "which conducted all negotiations with the management" (MUN 5/53; Hinton, 1973: 180).

The development of the Shop Stewards' Committee at the Royal Arsenal cut

through the layers of bureaucracy that existed between the War Office and its various departments. "The gained direct access to the highest levels of management" (Hinton, 1973: 180). "There was no beating about the bush with managers, shop managers or foremen: they went directly to the Supervisor (*sic*) or Chief Supervisor as required" (*Woolwich Pioneer*, 19 November 1915; Hinton, 1973: 180).

However, Hinton does not give any reason for this recognition or success of the collective agreements between the recognition of the Shop Stewards' Committee and the War Office. This tacit acceptance of trade union followed by full recognition, was due to the reforms of the Ordnance Factories in the nineteenth century. This included the introduction and application of machine tools, piece-working which also included longevity of employment, sickness benefits and eight-hour working day since 1894 and, more latterly, superannuation. The results of these tend to reflect reskilling through old craft boundaries (Cooper, 1984: 223), rather than deskilling as postulated by Braverman (1998), who suggested that such schemes led to short-term employment contracts, lay-offs and long-term unemployment. This was not the case at the Ordnance Factories. These benefits, representing the concepts of a philanthropic state employer, had hardly been touched upon within the contemporary private engineering industry, which still fought battles with the ASE over craft tradition and control of the workshop.

These two areas of conciliatory acceptance of dilution and the less militant structure of the ASE at the Royal Arsenal is a complete reversal of what occurred elsewhere in the engineering industry. As Hinton aptly describes:

"The fact that wartime dilution threatened not only the economic security of craftsmen but also the spiritual values that lay at the heart of their world outlook goes some way to explaining the ferocity of their militancy and their readiness at least to tolerate a leadership

which publicly attached revolutionary goals to this militancy." (1973: 98)

However, there was some militancy at the Royal Arsenal and indeed there was an episode of industrial action early in 1914 when a fitter called Entwhistle refused to work a job with non-union (ASE) labour. Another underlying factor for the lack of militancy within the Royal Arsenal Shop Stewards Committee was the elevation of a militant shop steward, Tom Rees, to the appointment of London District Secretary to the ASE, which was outside the remit of the Royal Arsenal, Woolwich.

During the First World War, the general Workers Union (WU), recruiting unskilled labour at Woolwich, was formed. Despite initial support between the ASE and WU in 1916, later issues soured this relationship, resulting in both unions reflected sectionalism which is a marked characteristic of British trade unionism. However, the Royal Arsenal branch of the ASE did participate in the strikes of May 1917, supporting colleagues in the private sector over the withdrawal of trade cards and the increased use of dilution. Despite this, Hinton pointed out that "subsequently ... the Woolwich engineers caused no serious trouble for the government" (1973: 185).

The Royal Arsenal Shop Stewards' Committee did not even provide a platform from which the more militant London Works Committee could be launched. This was because of "the unique position that the Woolwich engineers occupied outside normal collective bargaining procedures" (Hinton, 1973: 185). This too was due to the legacy of the nineteenth century reforms of the Ordnance Factories and the established collective bargaining structures with the Army Council.

Conclusion

This chapter has examined the period from the publication of the Morley

Report in 1887 to 1914. In this period the structure and management of the Ordnance Factories were centralised, which enabled the individual reforms of each government factory to be co-ordinated into the whole system. This was more evident with the stores inventory system. Again an overall DGOF was akin to the managing director of a company. The Director General had close communication with the Secretary of State for War and with Parliament, who were analogous to the shareholder body of a similar company in the private sector.

The period from 1890 onwards also witnessed some remarkable labour relations innovations within the Ordnance Factories, including the eight-hour day and flexible labour. The issue of women workers had much bearing on these reforms as, particularly with the Royal Arsenal at Woolwich, its success with 'dilution' production and restraint from militancy during the First World War, had much to do with the legacy of the reforms of the nineteenth century.

The next chapter examines the nineteenth-century legacy of the Ordnance Factories compared to the almost temporary experiences of the wartime Ministry of Munitions, particularly in relation to costing and DEB. Recent research into accounting and the First World War, particularly in relation to the Ministry of Munitions (Loft, 1986, 1988, 1994; Marriner, 1994) have left gaps as to the origins of these reforms. The next chapter addresses these, arguing that the origins of costing and DEB in the Ministry were part of the legacy of the nineteenth-century reforms of the Ordnance Factories.

CHAPTER 8

Re-inventing the wheel?

**The Legacy of the Ordnance Factory Reforms
compared to the Temporary Experiences
of the Ministry of Munitions
in relation to Costing and DEB**

Introduction

In May 1915, the Ministry of Munitions of War was created as a temporary wartime measure. The role of the new Ministry was to control, manage and administer the supply of all procurement for the armed services deemed to be munitions. The first Minister of Munitions was David Lloyd George, who had previously been Chancellor of the Exchequer.

The objective of this chapter is to argue that the previous reforms within the Ordnance Factories initially were not practised by the Ministry of Munitions, but were either ignored or forgotten. Evidence put forward in the Chapter 4 suggested that costings and DEB had been introduced into the Royal Arsenal, Woolwich from 1862 onwards by J.C. Hurst and H.W.S. Whiffin, the Assistant Accountant General. There is no evidence to suggest that these reforms had been removed by 1915.

Yet the official, though unpublished *History of the Ministry of Munitions* indicates that DEB was only introduced into the Ministry in March 1917, and costings later in 1917 (vol.3, pt.1, ch.3, p.80). No reason is given for the apparent demise of the Ordnance Factory reforms prior to 1914. The reason why the official *History of the Ministry of Munitions* ignored either intentionally or through ignorance the pre-1914 reforms may have been due to the retrenched Treasury policies towards the Ordnance Factories between 1904 and 1914. These policies have been either misunderstood or ignored by later writers of the period, including Lloyd George (1938), Adams (1978), Loft (1988, 1994) and Trebilcock (1975).

This chapter includes the evidence of the retrenched policies which by 1914 had reduced the reserve production capacity of the Royal Arsenal Woolwich to almost zero effect. The Ministry of Munitions was operating in a wartime corporatist

economy, a point which is sometimes not totally stressed either by Marriner (1994) or Loft (1994, 1998). When considering the merits or otherwise of the Ministry, one should take note of the wartime environment in which it operated. The aim of all major departments of state was to win the war. For example, Wolfe stated that:

"The sole preoccupation of the Ministry of Munitions, the Shipyard Labour Department of the Admiralty, the Contracts Department of the War Office and even of the Coal Controller's Department ... was with the war." (1923: 297)

Indeed, Harris had earlier said of war that it was most unbusinesslike (1911: 60), a point noted in Chapter 3. However, the pre-1915 Ordnance Factories existed in a liberal-orthodox *laissez-faire* economy, which acted as a catalyst for them to achieve the maximum levels of efficiency through internal reforms. The results of these reforms were hampered through the external Treasury-driven committees between 1904 and 1914, who were preoccupied with achieving short-term economies.

There is evidence to suggest that the formation of the Ministry of Munitions in 1915 did inherit the original reforms of the Ordnance Factories. Loft (1994), in her paper on accountancy and the First World War, leaves gaps as to where certain skills in costing may have originated. This chapter presents the argument that the reforms did permeate from the pre-1914 Ordnance Factories. This argument is supported, where possible, by primary source data. Although this data is not substantive, the corollary of all the evidence suggests that Ordnance Factories were the source of the subsequent reforms of the Ministry of Munitions, as identified by Loft (1994). Also, Sir Charles Harris, in evidence to an immediate post-1918 internal committee on the performance of the Ordnance Factories, hinted that the pre-1914 reforms were not continued in the Ordnance Factories when under the administrative control of the Ministry of Munitions from 1915 to 1919 (MUN 4/6375).

There are limitations in the scope of evidence relating to this chapter. In particular there is insufficient documentary evidence to produce any collective biography of military superintendents of the Ordnance Factories during the nineteenth century up to 1914. Part of this deficiency has contributed to the sometimes negative regard to the Ordnance Factories in relation to the contemporary private sector. This was mentioned in the previous chapter, and in particular the biography of Sir William Anderson by Davenport-Hines (DBB, 1984, vol.3 (A-C): 61-63). Few military superintendents qualified for a *Times* obituary notice. Major-General E. Maintland CB, RA, the first DGO of the Ordnance Factories, retired into obscurity in 1890 and died at Cheltenham in 1911. Unlike his successor, Sir William Anderson, Maintland was never afforded the privilege of a *Times* obituary.

However, one of the few military superintendents who was so honoured was General Edward Mourrier Boxer, FRS. Boxer spent most of his career in the Royal Laboratory (being superintendent there from 1860 to 1879) where he invented a number of improvements to ballistic science including the Boxer fuse cartridge, for which "he was the recipient of a special grant from Parliament" (*The Times*, 11th January 1898). But this contrasts with the bibliographical details in the *Dictionary of Business Biography* of George Kynoch, the ammunition manufacturer, who is accredited with a similar invention (DBB, vol.3 (H-L): 630-2; see also Chapter 5). Boxer gave evidence to the two Monsell Committees (1862 and 1863) and to the Morley Committee in 1886.

Most military superintendents of the Ordnance Factories, both in Britain and India, belonged to the Royal Artillery or the Royal Engineers. The common denominator in respect of initial military education of both gunner and sapper officers was

the RMA Woolwich, as previously described in this thesis. The major source of biographical information for both the senior military and civilian staff of the Ordnance Factories are the War Office Staff Lists held in the PRO Library. The biographical information within them only relates to their military or War Office career. Information of early history, where educated or family connections, is rarely given, but many military and civilian officials of the nineteenth century Ordnance Factories were just as innovative as Boxer, or as their contemporaries in the private sector. A number of senior military superintendents were Fellows of the Royal Society, as was Boxer. Others, particularly senior civilian officers, belonged to the Institution of Civil Engineers or the Institute of Mechanical Engineers. No official was a qualified accountant and it was very rare to find one in the War Office Staff Lists until the late 1950s (see Judge, 1981).

In order to amplify the comments made in the previous paragraph, it is worth looking at three civilian managers in the Ordnance Factories during the second half of the nineteenth century. The source for this information is the War Office Staff Lists held at the PRO Library. Henry Joseph Butter was appointed as manager within the Royal Carriage Department from 1873 and held this post until he retired in 1890. Butter had originally been appointed as schoolmaster to the Royal Arsenal School in March 1856. He became a draughtsman in the Royal Carriage Department in April 1862 and Constructor in June 1868 (War Office Staff List, 1891: 182).

Harry Travers (War Office Staff List, 1894: 227), a contemporary of Hay, was in 1898 superintending engineer and constructor of shipping at the Royal Arsenal. Travers began his career as an apprentice in the Royal Carriage Department, becoming a draftsman there in 1877. Travers was elected to the Institute of Mechanical Engin-

eers in 1888 (War Office Staff List, 1898: 326).

John Allen had entered the Royal Carriage Department as an artificer in June 1839, becoming master artificer at Malta in July 1852. Allen served in Malta throughout the Crimean War. He was transferred to the Royal Dockyard, Devonport in March 1861. In May 1866 Allen returned to the Royal Carriage Department as Second Constructor in May 1866, becoming manager in June 1868. Allen was the inventor of a self-acting brake for artillery (which is still used today by King's Troop, the Royal Horse Artillery). He retired in April 1873 (War Office Staff List, 1873: 124).

The 'servile state' - the beginnings of a corporatist state

The argument of this thesis has concentrated on the efficiency of the Ordnance Factories in relation to the evolution of professional management developments which mainly came from civil servants and civilian engineers cum managers. By the time of the second Anglo-Boer War the Ordnance Factories were more efficient in the production of munitions and armaments than the contemporary engineering / metal industry. The Ordnance Factories themselves existed within the political liberal doctrine of *laissez-faire* and the management reforms were both externally and internally linked. What must be borne in mind, particularly when assessing the post-1904 events described later in this chapter, is that the military superintendents and the civilian managers did not have total autonomy in the decision-making process of the Ordnance Factories. They were also governed by their political masters.

No war is ever efficient in terms of cost and production, nor are wars accurately predicted in terms of their duration. This is despite the evidence of historical

precedent, notably the Crimean War and the American Civil War. Neither are the costs of war correctly budgeted. This was as true in 1899 as it was in 1914. In relation to the second Anglo-Boer War, the Treasury in 1899 "calculated that the cost of the war would not exceed £10m and expected to recoup most of this from a swift annexation of the Transvaal gold mines" (Trebilcock, 1975: 147). By January 1900 the Royal Arsenal Woolwich "had to work a seven-day week and a three-shift day ... and it had to add £½ million worth of equipment to its capital stock" (Trebilcock, 1975: 147). Yet the Royal Arsenal fared far better than the private sector between 1899 and 1900. The political remit of the Ordnance Factories in time of war was "... only required to provide a rapid initial increase in output - by 50 per cent within the first four to six weeks of hostilities" (Trebilcock, 1975: 147). However, the Royal Arsenal continued the increased 50 per cent production rate throughout 1900 despite the political objective, requiring it only "to carry the burden of munitions demand only at the commencement of the war" (Trebilcock, 1975: 147).

The political rationale was to allow time (up to six weeks) for the private sector to ratchet up its production capability to meet the munitions demand for the Army in the field. This did not happen either in 1900 nor in 1915. The private engineering / metal industry in Britain in 1899 was not logistically capable of meeting this demand. The craft workshop mentality generally prevailed. Engineering managers were constantly concerned with the monitoring and control of labour in order to diffuse what was still an acrimonious industrial relations arena.

The Ordnance Factories had resolved these problems some forty years earlier. However, the outcome of the second Anglo-Boer War was not totally satisfactory to the Ordnance Factories which, despite their 50 per cent increase in munitions output,

also failed to meet the procurement demands for the Army in South Africa. In fact the Ordnance Factories were politically penalised for their relative success compared to the private munitions factories who were rewarded for their relative failure. In spite of the retrenchment which followed from 1904 to 1914, the Ordnance Factories were still very efficient in terms of management. The initiatives put in place from 1862 remained in place and were there when the Ordnance Factories were transferred from War Office control to the Ministry of Munitions in 1915. The creation of the Ministry of Munitions was as a direct response to the failure of the ratchet policy, which had failed both in 1899 and again in 1915. By 1915, however, the era of *laissez-faire* was being quickly superseded by the corporatist state.

The decade from 1904 to 1914 witnessed a massive rise in public expenditure due to the cost of the South African war and to the emerging servile state. The meaning of the term 'servile state' suggests that there was a growing encroachment by the state into the affairs of the private sector. From the last decades of the nineteenth century the state became involved in the labour market, bringing in the eight-hour day under the Fair Wages Resolution, as described in the previous chapter. By the first decades of the twentieth century to 1914, the state was becoming increasingly involved in trade union legislation (1906), social security (1909), labour exchanges (1909) and National Insurance (1911). Also, from 1905 the largest element for the defence budget was naval expenditure, in order to finance a major naval rearmaments programme. In terms of small arms manufacture, the War Office began to place more orders out to contract. The private armaments industry which had fared so badly in procurement supply during the second Anglo-Boer War were encouraged to expand.

Until the second Anglo-Boer War (1899-1902) only the Royal Small Arms Factory at Enfield and its two satellites at Birmingham supplied the Army and Navy with small arms on a regular basis, with the weapons made on the process of interchangeability.

It was just prior to 1899 that the BSA factory received large orders for the production of the magazine-fed Lee Metford rifle and, with the development of the machine gun, new firms such as the Gatling Gun Company were formed, able to produce machine guns through mass production. For BSA this was the first large Army contract they had received since the Snider conversion some thirty years previously.

From 1904 a number of other private arms manufacturers were established including the Naval armaments factory called the Coventry Ordnance Works in 1904.

Warren states that:

"The origins of the Coventry Ordnance Works are to be found in the engineering economy of the West Midlands in the 1880s and 1890s when traditional trades were being replaced by new lines connected first with the booming cycle business and later with the early motor industry." (Warren, 1998: 140)

Part of the reason for the establishment of the Coventry Ordnance Works was due to changes "in Admiralty procurement policies" who were "encouraging an ability to provide a comprehensive heavy armaments package" (Warren, 1998: 141).

The Coventry Ordnance Works were associated with the shipbuilders John Browns and Cammell Laird, who wished to secure more comprehensive orders for naval capital ships in the face of competition from Vickers. However, the Coventry Ordnance Works were not a total success and the company nearly went into liquidation in 1912. The first two pre-1914 managing directors, Herbert Mullinger and Captain

Reginald Bacon, RN were not successful in either obtaining naval contracts nor in managing the Coventry Ordnance Works.

Captain Bacon had been on the staff of the designs committee, which had drawn up plans for the Dreadnought class of battleship. He became the first captain of HMS Dreadnought. From 1907 to 1909 Bacon became director of naval ordnance and torpedoes, succeeding Jellicoe and was described by Fisher as "the cleverest officer in the Navy" (Warren, 1998: 148). He was not so clever, however, as managing director of the Coventry Ordnance Works and lacked "the conception of true business-like management" (quoted by Warren, 1998: 152). However, the First World War intervened and Bacon was recalled to the Royal Navy, duly tendering his resignation as managing director of the Coventry Ordnance Works in January 1915 (Warren, 1998: 155).¹

The Coventry Ordnance Works was saved from liquidation by Charles R.F. Engelbach, who was the son of Lewis W. Engelbach CB, formerly Principal Clerk to the Director of Artillery, Woolwich and Assistant Accountant General at the War Office. Engelbach junior had become a premium apprentice at Armstrong Whitworth at their Elswick factory where he specialised in the manufacture of naval gun turrets and the development of reinforced steel. In 1906 Engelbach was commissioned into the newly formed Royal Navy Voluntary Reserve (RNVR) with the Tyneside Division as an engineering officer.

In August 1914 Engelbach was RNVR Inspector of Marine Engines at Grimsby and then posted ashore primarily to manage the 4.7 Howitzer Division of the Coventry

¹ Bacon became Second Commandant of the Royal Marine Artillery and commanded a heavy howitzer brigade of the Royal Marine Artillery with a Naval Brigade (BEF) France, 1914-15. Later, Bacon commanded the Dover Patrols, 1915-18 and was promoted to Vice Admiral and knighted (*Who Was Who*, 1919: 88).

Ordnance Works. Engelbach quickly rose to managing director of the now state-owned Coventry Ordnance Works and turned the company around from near-disaster to a successful munitions producer. For these services Engelbach was awarded an OBE (Civil) in March 1920.

In the 1920s Engelbach became perhaps one of the most successful and innovative production engineers of his generation. Engelbach was instrumental in saving the Austin Motor Company Ltd from the hands of the Receiver (DBB, 1984: 288-90; PRO ADM 337/117). The success of Charles Engelbach as an engineer and manager may have been due to his father's experiences at Woolwich in the latter part of the nineteenth century and the close proximity of the Royal Gun Factory. The Gun Factory at this time also produced naval ordnance and Engelbach junior may have had access to the factory.

In addition, the establishment of the Territorial Force in 1908 increased the demand for small arms, as the new Territorial Army was equipped to the same standard as their Regular Army counterparts, unlike previously with the volunteer movement.

Hinton argues that the origins of the corporate state began after the second Anglo-Boer War, with the origins of the servile state (1973: 30). In particular was the establishment of the Labour Exchange system. Hinton states that:

"Here it was not the integration with business that was most striking, but the continuity with the institutions of labour control erected by pre-war Liberal governments." (Hinton, 1973: 30)

According to Wolfe, writing in the immediate post-1918 era, the statutory establishment of the Labour Exchanges Act (1909) and the National Insurance Act of 1911 were examples of the servile state. Both Acts had anticipated an imminent war. Both

acted as a foundation for marshalling and distributing workers during the First World War, particularly in the engineering, shipbuilding and munitions industries (Wolfe, 1923: 68-69).

From 1904 to 1914 the private armament manufacturers began to polarise into three or four large companies and there was a general decline in the small-scale gun trade in the Birmingham district. These companies may have modelled their production criteria on the model of the Ordnance Factories, producing on a factory system using mass production methods similar to those used at the Enfield Rifle Factory from 1858, and the Birmingham-based BSA from 1863. Allen demonstrates this through census figures:

"which show a fall in the numbers of persons concerned in the industry from 5,500 in 1881 to 4,100 in 1911. Birmingham itself had less than 3,000 gunsmiths, as compared with about 6,500 fifty years previously." (1929: 191)

The major emphasis of government policy from 1904 appeared to prepare the private sector for any major expansion in time of war, where they could ratchet up production in a short space of time. This also appears to be the view of Trebilcock (1975). The opinion of Esher and other committees of inquiry into the outcome of the second Anglo-Boer War blamed the general inefficiency of the Army for the long delay in achieving any success in the field during the course of the War. When war came in 1914 the *laissez-faire* attitude of the private sector being able to ratchet-up very quickly to meet the munitions demand of the Army also proved futile.

By 1915 the economy of Britain began to move rapidly towards a corporatist state. The experiences and economic position of the Ministry of Munitions existed totally within a corporatist state but the earlier reforms of the Ordnance Factories, including costing and accounting, evolved from a *laissez-faire* political doctrine from

1855. The nineteenth-century Ordnance Factories had reformed themselves in order to survive within a prevailing philosophy of *laissez-faire*, particularly at its most dominant points: 1855 to 1870 and 1904 to 1914.

Part of the problem faced in any historical assessment of the Ordnance Factories is that much of what has been written tends to be subjective. This may be due to the belief that the private sector was inherently more efficient due to the profit motive and competitive element. Recent writers also tend to support the premise that compared to private armament companies the state-owned Ordnance Factories were not efficient. Davenport-Hines (1984), in his biography of Sir William Anderson, quotes from evidence given by Sir Charles Harris to the 1919 Committee of Inquiry into the performance of the Royal Ordnance Factories during the First World War.

Harris describes that the management of the Ordnance Factories was:

"... largely in the hands of military officers who in matters of pure industrial administration were themselves in the hands of managers and assistant managers ... who were not men with engineering degrees ... but men grown up from the bench. The general disposition was to regard accounts as an unfortunate necessity about which the less said the better... When offered to take any information out of the accounts which the superintendents and managers might find useful ... they asked for nothing and when put that information before them which thought they ought to be in a position to refuse, they made no use of it." (Davenport-Hines, DBB, 1984, vol.1 (A-C): 61, quoting from PRO MUN 4/6375)

The document MUN 4/6375 relates to the Committee of Inquiry into the Royal Ordnance Factories and in particular the evidence given by Harris as Assistant Financial Secretary to the War Office. The actual evidence was given to the Sixth Meeting of the Costs Sub-Committee, on 27th January 1919. The piece quoted by Davenport-Hines does not relate to the whole theme of evidence given by Harris. Although Harris admitted the accounts of the Ordnance Factories "had served a very

valuable purpose ... he [Harris] was entirely in sympathy with the view that sufficient use had not been made for them for internal administration". Indeed, Harris considered that the "foundations of the accounts were absolutely sound and solid, and he hoped that in any changes made it would not be necessary to interfere much with primary records". Harris praised "the main feature of the Woolwich system of accounts" which was "the independent record by the work-taker, and he imagined that that stood unchallenged as a primary record" (MUN 4/6375, evidence of Sir Charles Harris, Sixth Meeting of the Costs Committee, 27th January 1919).

The earlier statement quoted by Davenport-Hines was later qualified by Harris as a problem faced during "the past four years [when] the ROFs [Royal Ordnance Factories] had been separate from the War Office" (MUN 4/6375).

During the First World War, particularly when the Ordnance Factories were controlled by the Ministry of Munitions (1915-19), there was a problem in the valuation of work in progress. Harris referred to the work in progress as semi-manufacturers. There was a difficulty in their valuation, however this had not been a problem before 1915. It would seem that the difficulty occurred in the collation of appropriate information from the record system, which was an overall problem faced by the Ministry of Munitions generally.

Harris thought that:

"a great deal could probably be done by abstracting the primary records in various ways useful for internal control and for furnishing information at the very earliest and most frequent dates at which the managers and superintendents could make use of it for the current control of the work in the shops." (MUN 4/6375)

The Chairman of the Sub-Committee referred to the earlier audit of the Woolwich accounts system by Morland in 1902, by stating that:

"The cost account system at Woolwich was fully inquired into in 1902 by Mr. Morley of Messrs. Price Waterhouse ... who examined the systems obtained at certain private engineering establishments and, speaking generally of his enquiry, he stated that: 'The system of cost accounting at Woolwich appears as well adapted to obtain the results required as that of any works visited. These results differ in character from those of commercial houses, owing to the absence of profit considerations and to the requirements of Parliamentary Returns'... In 1902, however, the modern commercial system of costing was hardly known, since then the developments in engineering costings and the recognition of the importance of up to date accounts capable of affording short-period results and comparative statistics for managerial purposes ... have enormously advanced." (MUN 4/6375)

Harris identified the time lag as a major factor in accounting within the Royal Ordnance Factories between 1915 and 1918. He argued that the delay was caused by translating the primary records into a consolidated account in order to process the annual Parliamentary Returns. An article on 'Army Accounts past and present', published in 1923, stated:

"It has probably been a very great surprise to many people to read that the Army, until a few years ago, had nothing worthy to be called by the name of accounts. One can imagine the taxpayer exclaiming, 'What no accounts and spending fifty millions a year'. The old method completed but one account - a cash statement of sums received and paid on Army services - and this was the only account presented to Parliament. Estimates of expenditure for Parliamentary sanction on the same basis. The only control Parliament possessed was in regard to the total amount, for the method adopted was to show expenditure under its various classes only, without relation to objects." (*The Balance*, vol.1, no.3, summer 1924: 100)

At the time of giving his evidence, Harris as Assistant Financial Secretary to the War Office, was engaged in the nucleus of a cost accounting experiment within the War Office. Accounts 6 Department had been formed at the War Office in 1917. Later, in November 1919, the Cost Accounting experiment was introduced into the British Army generally, but its experimental status meant that the original cash system remained in tandem with the new cost accounting system. The cost accounting

experiment in the British Army was terminated in 1925. In 1995, the Treasury introduced RAB into all government departments, which included commercial concepts of accounting including DEB, accrual accounting, and depreciation provisions. These were accounting concepts introduced into the Ordnance Factories by Whiffin and Hurst from 1862 onwards. Harris introduced these concepts into the cost accounting experiment in 1919 but the traditional cash-based system returned in 1925 and remained the major accounting system for Parliamentary accounts until 1995 (Cm 2929, July 1995).

However, the assumed inefficiency of the pre-1914 Ordnance Factories has been highlighted by the few historians who have researched the British armaments industries, or the Ministry of Munitions, and by Lloyd-George himself who became the first Minister of Munitions.

The politics of retrenchment, 1904-1914

Lloyd George, in his *War Memoirs*, relates that when he became Minister of Munitions in May 1915, he inherited an inflexible system of Army procurement in the form of 'the Extract':

"'The Extract' is a term with an historical origin ... it was an extract from the proceedings of the Board of Ordnance which met at the Tower... The Extract was passed from official to official of equal rank who were not in a position to give orders to each other. An Extract ... is merely an order to do certain work. The Extract was backed up by [the] MGO, DDOS, SOS, DEOS, IRES and CSOF." (Lloyd George, 1938: 351)

Lloyd George refers to this system as being historical. However, the actual layers of alphabetical letters were relatively new. Trebilcock considers that the shell scandal of 1915 was due to the retrenchment of Treasury politics from 1904. He considers

in particular that the cause of the shell scandal was due to the recommendations of the committee investigating government factories and workshops (Cmd 3626, 1907, the Murray Committee). The Murray Committee was a Treasury appointed committee which investigated government factories and workshops. Its policy was to find ways of reducing the size and expenditure of the Ordnance Factories. The overall aim of the Murray Committee was to transfer "the expansion and contraction in armaments supply on the private armories" (Trebilcock, 1975: 152).

Trebilcock argues that "historians have not so far seized upon the point, but many of the difficulties of the Kitchener Armies in 1914 and 1915 began with this Committee" (1975: 152). The Murray Committee had two objectives in mind regarding the problem of armaments output. Murray examined these objectives as follows:

- "The economy of production in time of peace"
- "The power of expansion in time of war." (Trebilcock, 1975: 152).

The overriding economic aim of the Murray Report masked any lessons learnt from the second Anglo-Boer War and in particular the shell scandal of 1899, which was to be repeated again in 1914, though on a much larger scale.

However, whilst agreeing in principle with Trebilcock's argument, the Murray Committee was not the only cause of the shell scandal of 1915. There were other Treasury committees which will be explored shortly. The problem faced by Lloyd George first as Chancellor of the Exchequer in 1914-15 and then as the first Minister of Munitions, was not historically linked but was due to the Esher Report of 1904. Indeed, the Esher Committee examining War Office reconstitution in 1904 is equally to blame for the ensuing layers of bureaucracy which confronted Lloyd George in 1915.

The Esher recommendations were far-reaching and indeed did bring the governance and administration of the Army up to date. Esher ended the authority of the anachronistic Commander-in-Chief. This office was replaced by an Army Council of senior military and civilian personnel, together with fifteen subordinate Army directorates.

However, the down side of the Esher reforms reflected the immediate post-Boer War retrenched policies in terms of military expenditure versus military efficiency. This level of politics occurs after every war and is often Treasury influenced. Under the Esher recommendations the military APD and the civilian Army Contracts Department were abolished, albeit only temporarily. The mistake of Esher in the abolition of the APD and the Army Contracts Department was quickly realised, and the Army Contracts Department was resurrected in 1907 and the APD two years later, in 1909, due to the persistence of the Assistant Financial Secretary (Sir) Charles Harris.

The Esher Report also recommended the revival of the office of Master General of the Ordnance (MGO). The original office had been abolished during the Crimean War in 1855 together with the Board of Ordnance. From 1855 to 1904 Army procurement was the direct responsibility of the Secretary of State for War through his junior minister, the Finance Secretary (formerly the Surveyor General of Ordnance), and the Director of Army Contracts who was advised by the Ordnance Council. Designs, inventions, patents and new lines of production were submitted to the Ordnance Council prior to any decision being made, ultimately by the Secretary of State for War. Once approved, the Director of Contracts then invited tenders either through the Ordnance Factories or from the private sector. The system was flexible and ran efficiently and smoothly, given that until the second Anglo-Boer War the role of the

British Army was that of imperial and colonial policing rather than operating in the field as a large offensive army.

The re-emergence of the office of MGO added an inflexible layer over the existing system. Esher's recommendations generally aimed at the restructuring of the Army and its chain of command to compete with the armies of the central powers. Much of the philosophy behind the Esher reforms were learnt from the Admiralty reforms under Lord Fisher, but Esher suggested that the system of ordnance procurement as laid down in 1855 had outlived its purpose. It was considered that an executive officer with technical expertise was required, who could devote all his energies to the problem of munitions supply.

The Conservative Government under Balfour accepted this and the office of MGO, together with a new Ordnance Board, was made up of Army and Navy munitions experts to advise the MGO. There was nothing new in this structure. A similar structure had existed until 1855, the then MGO being Lord Raglan. The original office of MGO had been abolished in 1855 and was replaced by an Army Contracts Department headed by a Director of Contracts. The post-1904 MGO did not enjoy ministerial rank, as did the pre-1855 incumbent, yet there was an understanding that both the Army Council and Secretary of State for War were "to delegate to him full charge of munitions supply authority" (Adams, 1978: 10). This was of course without ministerial rank, authority or power.

The resurrected office of the MGO in 1904 replaced the disbanded Army Contracts Department. Esher had decentralised the contracting function to each of the newly formed fifteen Army directorates. The 1904 report's rationale behind this decision was to have an officer (the MGO) of "executive ability and technical expertise

to devote his full attention to munitions supply" (Adams, 1978: 10). However, the newly established Army Council and the Secretary of State for War could now delegate to the MGO the total role of munitions supply authority for the Army and disseminate the contract through the respective Army directorates.

Esher's plan to decentralise the contract function in the Army by abolishing the Army Contracts Department, along with its director, was not practicable. The system became confused and there was duplication and inefficiency as fifteen separate Army directorates contracted for similar procurement. The Army Contracts Department was revived three years later in 1907 as previously stated, but the office of MGO remained. This added a layer of bureaucracy to the procurement system which also led to inefficiencies, particularly from 1914 when procurement contracts were required on an unprecedented scale. The return in 1907 of the Army Contracts Department also went some way to explain the intransigence of the MGO in 1914. His authority, limited as it was in 1904, was further limited from 1907 onwards. Although the Director of Army Contracts was subordinate to the MGO, the process of procurement supply was further restricted due to an increased layer of bureaucracy. The Director of Army Contracts had less authority from 1907 onwards than he had before 1904 as his decisions had to be authorised by the MGO. This ultimately led to the decision to take munitions procurement from the War Office and transfer such responsibility to the new temporary and monolithic Ministry of Munitions.

Both Kitchener and the MGO, Major General von Donop, along with the senior military and naval munitions officers at the Ordnance Board, "never surrendered the view that only professional soldiers were qualified to express an opinion so technical as the supply of munitions to the Army" (Adams, 1978: 13). In other words, it could

be argued that both Kitchener and von Donop were taking the idea of the soldier-technologist to excess. Indeed, Adams also observed that "the problem of the Ordnance Department in its ability to overcome the munitions shortage began with its outlook" (1978: 13). Had the pre-1904 system existed in 1915, the shell scandal may have been less serious and the system more flexible to cope with the demands of the Great War, particularly the 1914-15 period.

When Lloyd George as first Minister of Munitions attempted to remove the Ordnance Board from War Office control and to infiltrate it with civilian experts, he was met by strong protests from the War Office. Indeed, the success of the transfer of the Ordnance Board from the retrenched grasp of War Office control was only achieved when Lord Kitchener was out of the country on a fact-finding tour in the Mediterranean theatre.

In considering the day-to-day management of the Ordnance Factories from 1899 to 1915, the prevailing culture and ethos was perhaps more paternalistic than the corresponding private sector, particularly the engineering industry. Overall at governmental policy level, the Ordnance Factories suffered from retrenchment policies of both Conservative and Liberal governments in the name of economy.

One of the first steps taken by Lloyd George when appointed as Minister of Munitions was to remove the CSOF, Sir Frederick Donaldson. Lloyd George refers to Donaldson in his *Memoirs* as "head of the Arsenal" (1938: 351). In fact Donaldson was head of all the Ordnance Factories, not just those on the Arsenal site. Lloyd George recognised his talent and appointed Donaldson to a new post of technical adviser to the new Ministry, but Lloyd George commented that:

"Years of routine in tranquil days when time did not count, when shells were manufactured to fire at safe targets ... and, above all, ensure that

the last penny provided by the estimates should be judiciously expended within the financial year, disqualified him for an emergency where hours were precious to the safety of the State." (1938: 351)

In his place Lloyd George appointed Vincent Raven from the London and North Eastern Railway, who had no experience of the armaments industry. Adams, in his appreciation of both Donaldson and Raven, considered that the Arsenal was a "poorly run system [which] could stifle a competent man until he was no use to a well-run one". He saw Donaldson as a case in point (1978: 137; note 9: 208). Again the contrast between Donaldson and Raven is somewhat misleading. Donaldson was CSOF of Ordnance Factories in a peacetime economy. He had to work according to the retrenched politics imposed through both Conservative and Liberal policies and rigidly enforced Treasury conditions, which will be shortly explained.

Raven worked in a wartime economy where, by the end of 1915, the Ministry of Munitions had adopted an almost 'black-hole' concept of production without adequate financial scrutiny or audit as the major objective of the Ministry was to win the war, rather than to be prudent with public money.

Une Vieille Boîte

When assessing the reasons behind the politics of retrenchment within the War Office Ordnance Factories, the notable contrast was naval expenditure, a point briefly mentioned earlier.

Ashworth commented that 1905:

"saw the launching of the Dreadnought which, by rendering obsolete every existing battleship, inaugurated a new era in which the world's navies restarted competition from scratch and it was the year in which reform equipped the Admiralty administratively to cope with a new era more efficiently than ever before." (Ashworth, 1969: 504)

The reorganisation and rearmament of the Navy under the Fisher reforms were at the expense of the Army. Thus most of the defence expenditure was channelled to the Admiralty vote.

Expenditure on the Army and Ordnance compared with the Navy from 1898 to 1914 was as follows:

"1,000,000 sterling

	Army and Ordnance	Navy
1898	19.3	20.9
1899	20.0	24.1
1900	43.6	26.0
1901	91.5	29.5
1902	92.3	31.0
1903	64.9	31.2
1904	36.7	35.5
1905	29.2	36.8"

(Mitchell and Deane, 1962: 397)

The upsurge in expenditure on the Army and Ordnance was due to the second Anglo-Boer War which was fought mainly on land and not at sea. However, from 1905 the Navy attracted more expenditure than the Army and Ordnance, a trend which continued to 1914:

"1906	28.9	33.3
1910	27.2	35.8
1911	27.4	40.4
1912	27.6	42.9
1913	28.1	44.4
1914	28.3	48.8"

(Mitchell and Deane, 1962: 397)

The logistical rationale behind this policy assumed that any forthcoming land war in Europe would be short and swift. This was modelled on the earlier Bismarck wars of the 1860s and the later Franco-Prussian War of 1870-1. The victor of such

a European war would be the one with moral advantage and supremacy at sea! Unfortunately the order of battle did not proceed to plan and the land war was not resolved in a few weeks. The lessons of the Crimean War and the American Civil War were not considered in the assessment of any future European war.

However, as this was the prevailing logistical philosophy from 1904 to 1914, it was the Ordnance Factories which bore the brunt. Equally, having an MGO as a military officer of non-ministerial rank made him subservient to his political masters, more notably the Treasury. Commentators writing on the inadequacies of industrial mobilisation and the shell scandal of 1915 have been quick to blame the Ordnance Factories and their management for this (Lloyd George, 1938; Adams, 1978; Loft, 1994; Trebilcock, 1975). The major reason was, however, the trade-off of defence expenditure in favour of the Navy. Also, there were growing demands for the financing of an emerging servile state as already described.

According to Lloyd George's *Memoires*, there was an atmosphere of low morale and inertia within the Ordnance Factories (Lloyd George, 1938: 99-104). Little in the way of capital investment had been spent since 1904 to upgrade their production processes. The most illogical part of this policy was that in the name of efficiencies the Royal Arsenal reserve production capacity had been removed by August 1914. The removal of the reserve production capacity from the Royal Arsenal may have been identified as a soft target by the Treasury in an attempt to redirect expenditure to a growing naval armaments programme and an emerging welfare state. No doubt this was achieved with Cabinet connivance. Two officers held the office of MGO from 1904 to 1914. Neither registered any protest about the run-down or removal of the reserve production capacity of the Royal Arsenal.

This is the Royal Arsenal witnessed by the French Munitions Minister, M. Albert Thomas, early in 1915. He described Woolwich as "une vieille boîte". In his *War Memoirs*, Lloyd George assumed that the system encountered by M. Thomas was historical (1938: 100-4, 160-1) whereas in fact it was not, it was only ten years old.

The adjective description of the Royal Arsenal as "an old shop" only occurred from 1904 onwards and was due to the retrenched fiscal policies of the Cabinet and Treasury towards the Ordnance Factories. These had been manifest in a number of interdepartmental committees sponsored by the Treasury in the wake of the Esher Report of 1904 on the reconstitution of the War Office. The interdepartmental committees included the Mowatt Committee (1904), the Henderson Committee (1907) and the Murray Committee (1906-7). Indeed, the Murray Committee spawned the internal Hadden Committee which sat from 1907 to 1910, it was chaired by the then MGO, Major-General Sir Frederick Hadden. It was the recommendation of the Hadden Committee which resulted in the removal and scrapping of the reserve production capacity of the Royal Arsenal, just in time for August 1914 (WO 32/8984)! In reality it was the recommendation by the Hadden Committee which relegated Woolwich to "an old box", in terms that for the first time the Royal Arsenal had no reserve production capacity.

The creation of the Ministry of Munitions from the summer of 1915 tended to obliterate the pre-1915 reforms of the Ordnance Factories. Apparently these reforms, particularly in the case of costing and DEB, were 'reinvented' by the Ministry.

The traditional interpretation of the perceived inefficiency of the Ordnance Factories probably originated through the *War Memoirs* of Lloyd George. Here, Lloyd

George casts a jaundiced eye on the 1914 Ordnance Factories. The first edition of his *Memoirs* was published in 1936, however recent historians have begun to reassess and be more critical of Lloyd George and his *Memoirs*. Historians are now considering that Lloyd George, when writing his memoirs in the mid 1930s began to distance himself from the events of 1914-18 in relation to the conduct of the war, particularly in relation to his position as Chancellor of the Exchequer, Minister of Munitions, Secretary of State for War and latterly as Prime Minister (see BBC documentary *Timewatch*, September 1998).

The Ordnance Factories were still in effect very efficient organisations in 1914 despite a ten-year reign of political retrenchment. In political terms, the Ordnance Factories could still supply munitions to the British Expeditionary Force (BEF) (mainly the Regular Army) in the field for the predicted short European land war. Had its reserve production capability remained intact it is possible that the shell scandal of 1915 would not have been so severe, nor as embarrassing. The increase in private firms from 1904 to 1914 also did little to stem the shortage of munitions during 1914-15. The major obstacle was the layers of logistical bureaucracy that had been created since 1904 and the removal of the reserve production capacity.

In order to appreciate the major reforms in terms of a professional managerial ethos which generated within the War Office controlled Ordnance Factories from 1855 onwards, the remainder of this chapter concentrates on the origins of costing, cost accounting and DEB at the Ministry of Munitions. The argument put forward suggests that these reforms originated long before 1914 in the Ordnance Factories.

The origins of costing and cost accounting at the Ministry of Munitions

Referring to an amendment to wartime emergency legislation, A.J.P. Taylor suggested that:

"the House of Commons did not realise [what it] was doing' when in early 1916 it added a clause to the Defence of the Realm Act (DORA) concerning the price which the war ministries would pay manufacturers for war supplies which it purchased from them. That price was to be the cost of making the items in question, plus an allowance for profit. This allowance for profit was to be based on the profit usually earned by the factory or workshop before the War." (Taylor, 1970: 66; Loft, 1994: 116; see also Lloyd, 1924: 58-60)

In assessing this, Loft does not totally consider the difference between the War ministries within a corporatist economy, and the pre-1914 economy of laissez-faire which the Ordnance Factories originally operated in. Much attention has been given to Lloyd George's deputy at the Ministry of Munitions who in August 1915 stated that "the astounding thing is that nobody seems to be able to tell us what things cost to make" (Addison, 1934: 116).

One week later, Addison recorded that:

"I am very relieved to have made proper arrangements for cost accounting for the control of the cost of new munitions factories, for revising our present tenders and so forth, and I have arranged with Black that Lever should be in full charge. I shall be very disappointed if he does not save hundreds of thousands of public money." (1934: 119)

From these statements there is an inference that the pre 1914 system of costing for contract was inefficient. In fact it was not. Addison was probably asking the wrong people for this information. Time may also have been a factor here as his autobiography was written in 1934, some nineteen years after the event. The system operated along the theme of efficiency and economy, through the laws of demand and supply. This can be seen from the statement by the Surveyor General of Ordnance (Lord Eustace Cecil) in his Annual Report to Parliament on the Army Contracts

Department, in 1878.

"Competition is resorted to as much as possible. This is the point at which we are most at variance with the proceedings of the commercial world. When a manufacturer or merchant finds a producer whose goods are excellent in quality, reasonable in price and exactly suited to his requirements, he will give that man his orders until the condition changes. Our system is rather this, that when a man has, by fulfilling all our wants, created a monopoly, we try to stir it. This is called 'buying on the cheapest market', it is the only system which those dealing with public money can pursue." (WO/395/1: 3)

The problem with the *laissez-faire* system in the first two months of the First World War was that it could not compete with the increased demand. The armed forces, particularly the Army, expanded to over 2 million in a short space of time. This included Kitchener's New Army which for the first few months of their existence were quasi-private organisations. The War Office did not take over many of the New Army battalions until well into 1915. The raising of such battalions was only sanctioned on the understanding that their administration, training and accommodation were initially the responsibility of their founders and sponsors. In many cases this was a local authority organisation.

From August to December 1914 the original method of supplying the Army through the Army Contracts Department, became an unregulated yet speculative market. Prior to August 1914, the Army Contracts Department had a list of approved (or ringed) contractors. After August 1914, this system had completely collapsed. Many of the New Army battalions were purchasing their equipment and accoutrements direct from the supplier and not through tendering via the Army Contracts Department. The speculative market was being encouraged due to unlimited demand, but limited supplies. Even competitive tendering became speculative tendering.

It was not necessary for a speculator to possess the goods. All that was

required was an option. The banks were more than willing to advance credit on a contract that would eventually be settled by an agency of the War Office. An example of this practice was made by Lloyd.

"A consignment of jerseys was bought by a firm of merchants at 3s.11d. each [19p] and offered to the War Office at 4s.5d. each [23p]."
(Lloyd, 1924: 19)

The Army Contracts Department refused this offer as it did not deal with wholesalers, retailers or middlemen but only with manufacturers. The policy of the Director of Army Contracts only tendering to manufacturers had originated in 1880. Lloyd gives the reason that the price offered was too high.

"The merchant then sold ... the jerseys to a provincial draper at 4s.11d. [24p] each. The draper then sold a considerable quantity of these jerseys to various local commands at 5s.10d. [26p] each and the balance went to firm of recognised Army contractors who resold them to a Territorial force association for 6s.6d. [33p] each." (Lloyd, 1924: 19)

Thus, by the latter part of 1914, the Department still sought to maintain their traditional principle but this was not easy, for wholesalers could offer stock immediately whereas manufacturers had to set up production lines and thus a time lag constraint existed. Wholesalers could anticipate the Army's requirements and place orders with manufacturers before a War Office contract could be negotiated.

The solution to this problem was to suspend the laws of supply and demand. This idea was suggested by Lord Rhondda, later Controller of the Coal Commission. Initially no form of nationalisation was agreed upon, but small firms with no experience of contracting for army contracts were encouraged to do so. They were also encouraged to form associations to tender for larger orders. Existing associations, as for example the Wholesale Clothiers Association, were encouraged to take the lead here. At its 1914 conference, the executive recommended co-operation with the Army

Contracts Department in the submission of tenders from their members at reasonable prices. The Department, in agreement with the Association for the supply of uniforms, at an all-round flat rate, for jackets, trousers and greatcoats. The War Office would supply the cloth at fixed issue prices. This method was encouraged by the Department so that by the end of 1914 the Association induced its members by voluntary arrangement to prioritise army contracts. In place of a continuous piecemeal demands and individual tenders, the Wholesale Clothiers Association arranged for the fragmentation of the total War Office tenders to all their members so that all got a share of the army contracts. This arrangement was planned ahead for several months in order to avoid time lags or for production to be switched to private wholesalers, who were eventually eliminated.

From this example, the Army Contracts Department created the nucleus of the first stage of national organisation and control of the factors of production, both by the War Office and later by the Ministry of Munitions from May 1915. Four principles emerged which became the major characteristics of this national organisation.

- The abandonment of the system of limited competitive tendering.
- Reorganisation by the War Office of trade associations and their co-operation.
- The introduction of effective agreements covering the whole of a particular trade.
- The substitution of a general uniform fixed price over a period of time for a multiplicity of individual contracts at different prices.

The origins of the system of cost plus pricing may, therefore, have been initiated by the Army Contracts Department, under the reforming zeal of a Board of Trade official U.F. Wintour, who was appointed as Director of Army Contracts in

November 1914. Wintour had been Exhibitions Manager at the Board of Trade and was appointed as Director of Army Contracts in November 1914, an appointment approved by Kitchener.

The embryo of the new Ministry of Munitions was formed in May 1915, and the first Assistant Financial Secretary and Accounting Officer to the new Ministry until November 1915 was Sir Charles Harris, who fulfilled this post with the equivalent post at the War Office. The War Office was responsible for the financial administration of the Ministry of Munitions until November 1915 (MUN 5/102/400/17).

Harris was succeeded by Samuel Hardman Lever, who was brought back from America to fulfil this role. Lever was a chartered accountant and one of Lloyd George's men of "push and go" (MUN 5/103/400/18; Adams, 1978: 40). Marriner described Lever as a practising accountant "with extensive experience of cost accounting" (1994: 454).

It was the policy of Lloyd George that the new Ministry should be staffed by 'men of push and go', insisting that,

"in the present case the interests of the economy and the safety of public funds will be best served by Mr. Lever's appointment in this capacity. He alone of the persons who may be regarded as available and suitable will have an intimate knowledge of the financial aspects of the enormous contracts which have to be made." (MUN 5/102/400/6 - H. Llewellyn Smith quoting Lloyd George to the Secretary of HM Treasury, 24 November 1915)

The point being made here is that Lever, though a chartered accountant, may have had a considerable knowledge of costings due to his American experience. This knowledge was not universally the experience of British professional accountants generally, as has been previously stated. However, consideration must be given to civil servants both within the Board of Trade and the Army and Navy Contracts

Departments who also had knowledge of costings, and indeed cost-plus pricing may have been a tool used in the Navy Contracts Department before 1915 (see Ashworth, 1953: 66-7). The Director of the Navy Contracts Department, Sir Frederick Black, was appointed as Director of Munitions Supply within the Ministry of Munitions in 1915. This was the Black Addison referred to previously. Sir Frederick Black and his colleague U.V. Wintour, Director of Army Contracts, were career civil servants.

It has been recognised by accounting historians that costing was not the remit of public and professional accountants, of which Sir John Mann (Lever's successor) was one. Loft correctly states that Urwick and Brech acknowledged the limited source of texts on cost accounting. This includes *Factory Accounts* by Fells and Garcke which, by 1914, had gone into six editions. Brech (1994) follows an earlier theme (Urwick and Brech, 1953, vol.II: 23) suggesting that *Factory Administration and Accounts*, first published in 1914, had a considerable bearing on the introduction of costing within the Ministry of Munitions and its agencies. Mann apparently sold 10,000 copies of Elbourne's book to munitions contractors.

Elbourne was not an accountant but an engineer working variously for Maxim, BSA, Vickers and Thornycroft. Brech (1994) explains that Elbourne may have learned costing techniques whilst in America from 1900 to 1902 although he admits that there is no corollary evidence to support this. Equally, Elbourne may have learned these techniques whilst at Thornycroft where he was employed in 1914. Thornycroft was closely allied to the Admiralty and the Navy Contracts Branch (see also E.F.L. Brech's unpublished thesis, 1994: 12). There is some suggestion that the Admiralty, particularly the Navy Contracts Department, and the Directorate of Naval Construction may have used costings in their decisions to place orders either in-house

or to contract. Ashworth stated that:

"the Admiralty had always sought from its appropriate technical branches a certificate stating that the price tendered and to be accepted was fair and reasonable... In giving these certificates the technical branches based their judgement mainly on comparisons between previous prices obtained by competition and with the costs of similar vessels built in the Royal Dockyards." (Ashworth, 1953: 107)

During the period of the First World War, Elbourne was employed as Assistant General Manager at Ponders End Shell Works, Middlesex.

The *History of the Ministry of Munitions* and later writers of the First World War and of the Ministry of Munitions appear to suggest that a system of costing existed in the Ordnance Factories before 1915 but without either admitting as such nor identifying the origins. For example, Loft relates that:

"A sophisticated system of costing was developed for the National Shell Factories 'which should yield for each process of shell manufacture statement of output, its cost in material, wages and establishment of charges and the extent to which each of these items was affected by faulty workmanship'." (Loft, 1994: 134, Note 8: *History of the Ministry of Munitions* (nd), vol.3, part 2, ch.1: 12-13)

The official *History of the Ministry of Munitions* itself does not describe the system as being sophisticated. It does suggest that:

"The new National Shell Factories provided, at least for the smaller nature of shell, both material for the ascertainment of costs and a field for the application of the results as an index for efficiency ... The average cost of each process through which the shell passed was ascertained and the addition of these costs gave the total cost of the shell. The costs so obtained are known as the 'Process costs', as distinguished from 'Unit costs'. This method permitted the closest comparison of the costs of each operation, not only for each factory week by week, but also between one Factory and another. The results thus indicated the relative efficiency of the management, and within each factory provided the managers with a clue to any leakage or extravagance." (*History of the Ministry of Munitions* (nd), vol.3, pt.2, ch.1: 13)

There are a number of important points to consider when assessing the origins of the costing reforms within the Ministry of Munitions. Firstly is:

- That the wartime economy itself allowed for such systems to be developed. The powers conferred upon the Government during the course of the War through emergency legislation and the quasi-nationalisation of private engineering cum armament firms, gave government agencies the right to assess the contractor's actual costs of production through the examination of his books. The *History of the Ministry of Munitions* acknowledges this point as follows:

"It is obvious that these Accountancy costs provide a much more powerful weapon in bargains. The contractor could always argue that the technical estimate did not in fact allow for the peculiar conditions under which he worked; and so long as he could conceal his actual costs, or (as was frequently the case), did not know himself what they were, the dispute could not be settled. But from the evidence of his own books there could be no appeal." (*History of the Ministry of Munitions* (nd), vol.3, part 2, ch.1: 13)

- It must be remembered that this intrusion into a contractor's accounts and records was not allowed by the Government before 1915 nor after 1918. The concept of commercial confidentiality prevailed in peace-time.
- The war-time measures were only temporary.
- Evidence from primary source data acknowledges that the Ministry of Munitions inherited a costing system but does not identify the source. The *History of the Ministry of Munitions* suggests that:

"The Ministry of Munitions from the earliest months of its existence practised all the possible methods of arriving at the costs of production. The first is technical costing, that is to say, the estimate of costs by engineering experts resulting from the analysis of the process of manufacture into its elements, and the calculation of what the cost of each of these factors ought to be in the light of all known conditions. Apart from the use, for purposes of comparison, of the Government Factory costs, this is the only method which could have been used by a Department before the War." (*History of the Ministry of Munitions* (nd) vol.3, part 2, ch.1: 10-11)

- Loft argues that:

"Another means by which techniques of costing spread was through the Ministry of Munitions inspectors and through their work with cost accounting." (1994: 124)

She continues that:

"In the case of the production of shells, government experts developed a sophisticated system of cost accounting for the National Shell Factories based on 'special costing forms'." (1994: 124)

Loft does not identify the origins of what she describes as the "sophisticated system of costing" (1994: Note 8: 134). Neither does Loft identify the actual government experts. Primary source evidence concerning the Ministry of Munitions acknowledges the existence of costings within the Ministry but provides no clue to its origins (MUN 5/107/450/2; MUN 5/107/450/3).

The origins of the "sophisticated system of costing on special costing forms" may have evolved from a system originally used, although in a simpler format at the Royal Laboratory. It is very difficult to substantiate this as primary source data, for the existence of such forms or other documentation are missing. Files relating in particular to a Memorandum on the System of Cost Accounting in the National Shell and Projectile Factories, and on the System of Accounting at the National Filling Factories (MUN 5/107/450/8 and MUN 6/107/450/10 respectively) are found to be wanting at the PRO Kew.

The arguments presented in this chapter are not being based on silence. However, taking together evidence that exists and as presented in Chapter 4 and in this chapter, the probabilities on circumstantial evidence does suggest that the origins of a costing system and DEB at the Ministry of Munitions originated from the pre-1915 Ordnance Factories. The PRO file, MUN 3, refers to original files relating to

National Shell Factories in Britain during the period 1915-19, under the control of the Ministry of Munitions. Apart from a specimen, the Rochdale National Shell Factory Accounts, the remainder have been destroyed. There is little in this file to suggest that the National Shell Factory accounts were any better or more sophisticated than the Ordnance Factory accounts.

However, although both Marriner (1994) and Loft (1994) have shown that the First World War elevated the status of both chartered and incorporated accountants, they acknowledge correctly that costings was not part of a professional accountant's remit. But Loft does show that they did in fact learn costing techniques whilst at the Ministry of Munitions. But there is little evidence or opinion suggested as to where the costing knowledge came from in the first place.

What appears to be a more reliable influence may have come from practises already in use in the Ordnance Factories and the use of the "special costing" forms. According to the official history of the Ministry, many private shell manufacturers accepted the offer to use these forms at their plants. This made the administration of accurate cost records more accurate and efficient (Loft, 1994: 124; *History of the Ministry of Munitions* (nd), vol.3, pt.2, ch.1: 12-13; Loft, 1994: 124).

However, Loft does not give any indication as to where the "government experts" came from, nor how they "developed a sophisticated system of cost accounting". Nor does she disclose the origins of the "special forms" (Loft, 1994: 124). Also, neither does the Ministry's official history identify these origins. It is argued that the origins of the sophisticated system of cost accounting, and the government experts, together with the special forms, originated in the nineteenth century Ordnance Factories. Evidence of this is to be found in the Morley Inquiry some 40 years

previously (particularly Appendix IX, Royal Gun Factory, examples of accounts and forms in use in the Department (C 5116) 1887: 535-552). Inspection, sophisticated cost accounting systems and accurate costing records all support the concept of scientific management and pieceworking. These had been developed within the Ordnance Factories from the mid-nineteenth century, as previously related in this thesis. The foundations of the costing systems in the Ordnance Factories had been laid down by Hurst and Whiffin some 60 years previously.

Despite a considerable search amongst the PRO documents relating to the Ministry of Munitions, it was not possible to trace 'a special form'. Again, if the official history of the Ministry made no reference to the origins of the costing systems, then the same history also did not relate to the origins of DEB in 1864, which is easier to substantiate as it is well documented by Hurst's evidence to the Morley Committee of 1887. Instead, the official history stated that DEB had been introduced in March 1917.

The document MUN 5/107/450/2 refers to a Report on the Conditions and Difficulties of the Ministry Accounts Department, Based on an Inquiry in MFI and MF Materials. The Report lists the objectives of the Ministry's Accounts as follows:

- "1. A complete account for each contract made by the Ministry both for cash and material.
2. Store accounts in quantities for all stores held on behalf of the Ministry.
3. Cost accounts for all factories operated by the Ministry.
4. A statement of cash payments and receipts by vote heads."

This Report is dated February 1917 and it outlines the system as operated.

This included:

- "a) A system of receipts and payments as distinguished from income and expenditure. This took no account of accrual or expenditure incurred, until a cash transaction took place.
- b) The system was accounted for on a single transaction entry basis only with all that system implies.
- c) The whole fiscal and operating systems were based, not on open accounts with manufacturers, but on contracts. Any transaction which cannot be traced, is not covered to a definite contract, or where traced, is not covered by the contract is susceptible of record.
- d) All goods are moved on instructions from the operating departments, made out on an Issue Warrant, and the evidence of movement is an Advice Note, made out in sexduplicate and distributed to the interested parties.
- e) No movement of goods is recorded at the time of its movement but only when the cash transaction, resulting therefrom, is made.

Such is the general theory of the accounts".

The second reference MUN 5/107/450/3 in November 1917 relates to "Efficiency in Production". The memorandum by George Duckworth to Lloyd George relates to cost accounting. In it Duckworth relates that:

"this branch of work seems to me to be one of the outstanding realisations of the Ministry of Munitions. The system was not, of course, actually discovered here, but never before, in this country has it been put to such extended use."

The Controller of Cost Accounts at the Ministry of Munitions, M. Webster Jenkinson, stated in a letter to George Duckworth of 28 October 1917 that:

"Cost Accounting can scarcely be termed a 'discovery of the Ministry of Munitions'. All that has been done is to apply modern costing methods to Government Factories; and, by the adoption of price-fixing

based on costs, to stimulate proper costing by outside contractors ..."
(MUN 5/107/450/3)

One year later in a lecture delivered at the LSE on 9 October 1918, Webster Jenkinson stated that:

"There appears to be a prevalent idea that the Ministry of Munitions has either evolved or imported from America a new system of Factory Costing, which, through the aid of some mysterious mechanical office appliances, enables cost results to be obtained with greater facility and more accuracy than hitherto has been possible.

It may, therefore, be disappointing to admit at the outset, that the so-called 'Ministry System of Costing' must be classed in the same category as the 'Russians who passed through England in 1914' and 'The Angel of Mons' no such special system existed except in the minds of certain contributors to the accountancy papers ...

The distinguishing feature about the costs obtained by the Ministry of Munitions is, however, that the results have been obtained monthly, and may have been used, and very effectively used, by the management for administrative purposes and by the (Army) Contracts Department in fixing prices paid to outstanding contractors ... the Ministry of Munitions has appreciated what so many British manufacturers fail to do, viz that efficiency management is only possible if reliable records of progress, production costs, and other statistical data are available."
(MUN 5/107/450/9)

There are also errors in Webster Jenkinson's account of the American origins of cost accounting. There is little doubt that Lever brought into the Ministry of Munitions his experience of cost accounting gained in the United States. The ethos of Webster Jenkinson's lecture was subjective in an attempt to portray the Ministry of Munitions as an innovator and contributor to the war effort. The fact that the war was still being fought suggests that an element of propaganda is also tainted in his lecture. The warts of the Ministry have been omitted, in order to achieve a public relations exercise, which is not uncommon in wartime governments.

Whilst rejecting the American origins of cost accounting at the Ministry of Munitions, he is not totally explicit either as to its origins. However, as Webster

Jenkinson was a chartered accountant there is the assumption that he was also promoting the professionalism of both chartered and incorporated accountants as being the instigators of cost accounting into the Ministry.

However, there is ample evidence to refute this. Both Marriner (1994) and Loft (1994) have referred to the lack of interest taken by the British accounting bodies in cost accounting. Contemporary evidence suggests this too. Again, Miles Taylor ACA, in a letter to *The Accountant* on scientific costing, suggested that in his opinion:

"Chartered accountants are only now beginning to see the possibilities of cost-finding as a vital branch of the profession. How many men at the Admiralty, War Office, Ministry of Munitions - or the Coal Controllers - knew the first thing about it? Anyway, we should all be wiser for the experience gained during the war. Many of our leading manufacturers and distributors are keenly interested, and are looking for expert accountants for guidance." (*The Accountant*, 5th April 1919: 277 - letter dated 28th March 1919; Loft, 1994: 134, note 11)

Until 1917 and possibly beyond, the financial administration of the Ministry of Munitions was chaotic. DEB was only introduced in March 1917, some three months after Lever had vacated the Ministry of Munitions to take up the political appointment of Chief Secretary to the Treasury.

The origins of both cost accounting and DEB at the Ministry of Munitions originated from the pre-1915 Ordnance Factories. Webster Jenkinson hinted at this in his LSE lecture through acknowledging the contribution made by the Army Contracts Department. One week after his lecture, Lieutenant Colonel James Grimwood, special adviser to Harris and head of the experimental Accounts 6 Department at the War Office, also delivered a lecture at the LSE on 'Costing in Britain to Government Control, Efficiency and Economy'. Unfortunately Grimwood's lecture was not promoted or preserved as was that of Webster Jenkinson. However, the *Incorporated Accountant* did publish extracts of Grimwood's lecture during March, April and May

1919. The earlier reforms of the Ordnance Factories apparently did not become recognised in the Ministry of Munitions but their successor was the cost accounting experiment in the Army from 1917 to 1925, pioneered by Harris and Grimwood.

The introduction of DEB into the Ministry of Munitions = a reinvention of the Wheel?

Evidence related to the inefficiencies in the accounting system within the Ministry of Munitions which failed to meet set objectives. This was due to cash only based accounting methods, single-entry book-keeping and the maintenance of only contractor records (MUN 5/107/450/2). This was occurring in the second year of the Ministry's existence at a time when about three hundred and forty professional chartered and incorporated accountants had been deployed to the Ministry as temporary civil servants (*The Incorporated Accountants' Journal*, July 1918: 187).

The official history quotes J. Guy, the Director of Munition Accounts who stated that:

"The accounts were kept by single-entry, upon a system of receipts and payments (as distinguished from income and expenditure). This meant that the accounts took no cognisance from income accruing, or expenditure incurred, until some cash transaction resulted." (*History of the Ministry of Munitions* (nd), vol.III, part 1 viii: 80)

Guy sat on an advisory committee which in 1917 found the following inefficiencies within the Ministry of Munitions.

Guy commented that:

"While the whole fiscal system is based on contracts, we find:-

1. That many contracts have been made without record in the Accounting Department.
2. That we cannot trace the present location of many of these contracts

with the accompanying letters, nor is there a complete file anywhere.

3. The modifications are made without report to us.
4. The prices of sale are made without authority from the Contracts Department.
5. That many transactions occur without contract.
6. That contracts are made without the purchase price being fixed.
7. That all the transactions under contracts are not covered in terms, especially the all important matter of material supplied by the Ministry." (MUN 5/107/450/2)

The Advisory Committee recommended the following reforms:

"The appointment of a proper authority to coordinate finance and operating departments, and to see that plans adopted are adhered to:-

- a) As to the form and distribution of Issue Warrants and Advice Notes,
- b) As to notification in advance of new enterprises
- c) As to fixing of prices on direct sales
- d) As to securing supervision in the use of free issues of materials
- e) To see that all stores are brought under the jurisdiction of a Central Stores Authority." (MUN 5/107/450/2)

Guy concluded:

"The installation of a double-entry system of accounting capable of sectional balancing appears to us to be imperative. Such a system has been carefully considered and approved by the Financial Heads of the Ministry, but the requirements set out above are conditions precedent to satisfactory operation of my system ..." (MUN 5/107/450/2)

The official history of the Ministry of Munitions records that double-entry was recommended by the Advisory Committee in their Report of 9 March 1917 as follows:

"that the book-keeping system of the Finance department and its branches throughout the Ministry be changed to the best commercial practice as from 31 March 1917." (*History of the Ministry of Munitions* (nd), vol.III, part 1, ch.III: 80)

Nowhere either in the Ministry's official twelve volume history, nor in the surviving records of the Ministry of Munitions is there an acknowledgement of the earlier reforms of the management and accounting systems of the Ordnance Factories. Indeed the Ministry's treatment of depreciation was similar to that experienced in the private sector, a point noted by the Comptroller and Auditor General, who stated in his Report for 1917-18 that:

"the accounts (for the Ministry of Munitions) include for the first time depreciation charges which have been calculated from the commencement of operations at each factory; reserves have been created and the production accounts have been duly charged. The rates fixed by the Ministry vary with the class of the asset, and are stated to be in excess of those generally adopted in commercial practice under normal conditions. At certain of the explosive factories depreciation has not been charged on plant for periods during which it has been 'idle' ..." (Ministry of Munitions Appropriation Accounts, CAG Report 1917-18, para.61, MUN 5/106/400/6)

The origins of the cost accounting experiment and the formation of Accounts 6

Branch at the War Office

This thesis has argued that the origins of the cost accounting experiment in the British Army came from the nineteenth-century reforms of the Ordnance Factories and not from the Ministry of Munitions. The link between the pre-1914 Ordnance Factories and the cost accounting experiment was Sir Charles Harris, the Assistant Financial Secretary.

Harris had persuaded Parliament to establish a sub-committee of the PAC to inquire into the form of public accounts. He was critical of the traditional system of Parliamentary accounts, commenting: "but when you come away from that pure question of accountancy, and come to the control of expenditure, then I should propose to depart from the cash basis altogether" (BPP, 1918, vol.iv, pp.334: question 220).

The Treasury were not totally enthusiastic about change. Sir John Bradbury, the Joint Permanent Secretary to the Treasury, defended the status quo, arguing that:

"In criticising the existing scheme of appropriations of Parliamentary grants, it must be borne in mind that the control of expenditure, in the sense of securing the various public services are efficiently administered at a reasonable cost, was as part of the object which the framers of the [new] system had in view." (Memorandum by Sir John Bradbury and quoted in the Seventh Report to the Public Accounts Committee, 1918)

The green light for the cost accounting experiment was given in November 1917. Accounts 6 Section was established at the War Office to pilot the scheme. An incorporated accountant and Army officer, Lieutenant Colonel J.M. Grimwood DSO FSAA SWB, was appointed to command Accounts 6 Section and to act as special adviser on cost accounting to Harris. Accounts 6 Section had two offices, one at the War Office, the other at Woolwich.

The staff at Accounts 6 at the War Office included five professional accountants (including Grimwood) and three professional accountants loaned from the Ministry of Munitions, twelve civil servants and three military clerks. The function of Accounts 6 was to audit the factory accounts, including the cost accounts of the Ordnance Factories. This was a function which had been the responsibility of both Hurst and Harris in the nineteenth century and it is argued that the cost accounts were similar then as in 1917.

The function of the sub-department located at Woolwich included the examination of wage, store and the manufacturing accounts under the following vote heads:

- | | |
|--------|--|
| Vote 6 | Supply Reserve Depot, Woolwich. |
| Vote 7 | Clothing stores and factories at Pimlico and Marylebone. |
| Vote 8 | The Army ordnance departments located at Woolwich (the Royal Arsenal and at Woolwich Dockyard), Purfleet, Park Royal and the |

Stationery Store.

Vote 9 Inspection of the engineer stores and factories at Soho, Kilburn, Cricklewood and Teddington.

Inspection of the Ordnance College, Woolwich and the workshops and experimental establishments at Woolwich.

The sub-department at Woolwich was headed by Harry Douglas Leather ACA, who was normally a partner in the Leeds firm of chartered accountants, Leather and Keale.

The findings of initial research conducted by Accounts 6 Department were presented as the Seventh Report to the Select Committee on National Expenditure during the session for 1918. The report criticised the non-significant character of the then present form of estimates and accounts, suggesting that it contained little value for the purposes of control.

However, the report contained evidence which supported the argument by Harris for a total reform of the accounts and the following statements were given to support Harris:

"We cannot make much use of the Appropriation Accounts for administrative purposes; we rely on the Commercial Accounts ..." (Sir Charles King, Comptroller and Accountant-General of the Post Office)

"If you wish to establish financial control it can be better effected by the objective rather than by the subjective scheme. I have always felt that the subjective classification, though very simple and convenient, did not lend itself to establishing a unit of cost by which you could control and compare the cost of one service with another." (Sir H.J. Gibson KBE, Comptroller and Auditor-General)

"I do not think Estimates as furnished in the past to Parliament are worth the paper they are written on from the points of view of Parliamentary control." (S. Dannreuther CB, Accounting Officer of the Ministry of Munitions)

Harris concluded:

"You cannot get any real control of expenditure by cash issues or cash payment excluding such factors as liabilities, consumption of stores from stock and things of that sort. You cannot control administration by controlling expenses on subjects. *If you want to control administration by appropriation you must appropriate to objects.*" (Sir Charles Harris KCB, Assistant Financial Secretary to the War Office)

Other problems of the existing system were also highlighted:

- **Classes of accounts are not consistently on objective lines.**
- **The total cost of the services for which they provide is not disclosed either in Estimates or Accounts.**

The situation was not much better in the contemporary private sector, either before 1914 or after 1918. Warren, referring to the Coventry Ordnance Works, as mentioned earlier in this chapter, describes how the transition from a wartime:

"... to a more cost-conscious, competitive peacetime regime proved psychologically difficult. A.H. Sturdee, given the job of trying to make the Coventry Works commercially viable, later referred to his difficulties in getting 'the aspect changed from the more generous ordnance ideas to the strictly economic basis necessary for competitive electrical manufacture'." (Warren, 1998: 182)

Warren admitted that the problem was a general one. Part of the Cammell Laird group was the Sheffield-based Cyclops Steel Works, whose accounting system was inspected by Price Waterhouse in February 1918. The objective of this had been to establish an accounting system "with a view to the introduction of modern methods" (Warren, 1998: 182). The report from Price Waterhouse found that at Cyclops:

"There was no costing system. The Manufacturing Costs have never been properly balanced with the Financial Books... The Time and Material Records at Grimesthorpe are very unreliable, and the methods of charging Time, Material and Indirect Charges to work are also so irregular that the Cost Data hitherto produced must have in these considerations alone seriously misinterpreted the actual position... The Costs at Penistone are only Annual Costs and are therefore of little worth; furthermore, no distinction is made between different grades of various products, all being thrown into one set of costs." (Price Waterhouse Report, quoted by Warren, 1998: 182)

It is worth comparing this observation of 1918 with the earlier report in 1902 by Morland, of Price Waterhouse, into the accounts of Woolwich, as stated earlier in this chapter. As with other reforms initiated into industry during the First World War, they only proved to be temporary. The management of the Cyclops Steel Works, in thanking Price Waterhouse for their report, stated that:

"After careful consideration we have decided that, owing to the ever increasing pressure of war work, it is not possible for us to proceed rapidly with any scheme of reorganisation and that the steps taken must necessarily be conditioned by the greater urgency of war requirements." (Warren, 1998: 182)

According to Warren:

"This perfectly reasonable response meant the company carried over a ramshackle system into the next few years, in which a worsening operating environment provided a keener test of its efficiency. The hopefulness of the early post-war period then passed over into contraction, to stagnation and eventually to blank despair." (Warren, 1998: 182)

Conclusion

The transformation of the Ministry's management and accounting system, some two years after its formation, may only reflect a re-invention of the wheel! In essence, the reforms of March 1917, re-discovered the original system within the government manufacturing departments that existed from 1862, the original architects being H.W.S. Whiffin, J.C. Hurst, and John Anderson. Much of Guy's Advisory Committee into the internal operations of the Ministry of Munitions only re-invented procedures recommended for the Ordnance Factories by Monsell (1862, 1863) and by Morley (1887).

A minute written by Mann of 5 March 1917 stated that measures had been implemented to carry out the recommendations of the Advisory Committee. This

included, to substitute:

"the contractor for the contract as the book-keeping unit. At present each contract was dealt with separately; in future, there was to be an account for each contractor, summarising his contracts." (*History of the Ministry of Munitions* (nd), vol.III, part 1 viii: 81)

These changes have influenced later historians in believing that it was the professional accountants, industrialists and entrepreneurs who were deployed as temporary higher division civil servants in major government departments, which influenced public sector management and accounting during the First World War, and in the post-1918 period. Most of these temporary civil servants were employed in the War Office, the Admiralty, the Ministry of Munitions and the Coal Commission (Marriner, 1994; Loft, 1986, 1988, 1994). These 'reforms' included the revised system of management and accounting with the Ministry of Munitions from March 1917, and the cost accounting experiment in the British Army from 1917 to 1925 (Wright, 1954).

For example, the Controller of Munitions Accounts, Sir Gilbert Garnsey, stated that:

"The result was that, as at 31 March this year (1917), the whole of the accounts of the various sections of the Ministry were put upon a double-entry basis, so that any payment that is made day-to-day does not automatically, as it used [to] in the old days, get written off and disappear, but it is charged up to the section which as to account for it. That is really the sum and substance of the whole difference between the accounts on the single-entry basis and on the double-entry basis." (*History of the Ministry of Munitions* (nd), vol.3. part 1, ch.3: 80)

The official history of the Ministry suggests that the failure of the financial and accounting systems was not the fault of Lever, but rather to the enormous increase in the Ministry's business. However, Lever had overall responsibility and despite the influx of the men of 'push and go', the structure of the Ministry of Munitions reflected

an inflexibility where delegation was found to be wanting (*History of the Ministry of Munitions* (nd), vol.3, part 1: pp.26-27).

The major points relating to the financial administration of the Ministry of Munitions are again reiterated for reference:

- Until March 1917 there was no proper accounting system beyond a cash based single-entry method of recording.
- The movement of stores and supplies was not centralised, nor were the issue of Advisory Notes and Issue Warrants satisfactorily controlled.
- Records were kept loosely on a contract basis. This led to many errors of commission and omission which could not be traced under the existing accounting system of single-entry.
- The existing system was heavily overstaffed, under utilised, causing a duplication of effort and inefficiencies. This is despite that by July 1918 there were about 340 chartered and incorporated accountants acting as temporary civil servants in the finance, contracts, accounts and audit departments of the Ministry of Munitions (*The Incorporated Accounts Journal*, July 1918: 187-88; Loft, 1994: 125).²
- The introduction of costing into the Ministry of Munitions was not due to the influence of the professional accountants employed there from 1915 to 1919.

Despite the apparent reforms, there were still problems with the monolithic Ministry of Munitions. In a memorandum of 3 October 1917, the chief accountant

² In answer to a Parliamentary question in dealing with illegal maladministration at the Ministry of Munitions, 'Flapper Finance', it was pointed out that "In the finance, contracts accounts and audit departments of the Ministry there are unfortunately less than 1 per cent of permanent civil servants, but we have secured the services of many businessmen and about 340 Chartered and Incorporated Accountants" (*Incorporated Accountants Journal*, July 1918: 187).

at the Ordnance Factory, Chilwell, Notts (a shell filling factory), reported that the invoices received from the Ministry of Munitions were:

"full of errors and they propose to have a particularly bad one framed as a permanent example of the difficulties the Factory have experienced in connection with the Ministry's financial invoicing." (MUN 5/108.450/32 - Papers on Costing in Filling Factories).

The Ministry of Munitions only produced its first balance sheet in April 1918, some three years after its formation. The use of costing within the Ministry and its use in private armament companies was to satisfy wartime measures only in an attempt to reduce profiteering. The structure of the Ministry into departmental components allowed for cost accounts to be established, albeit by a slow process. There is little doubt that Lever's enthusiasm for costing was due to his American experience rather than from any involvement with the ICAEW or with British accountancy generally.

However, the transition into a peacetime government department did not affect the Ministry of Munitions but the War Office, and it is argued that the rationale behind the cost accounting experiment in the British Army was influenced by the pre-1914 reforms of the Ordnance Factories and in particular by Sir Charles Harris, Assistant Financial Secretary to the War Office. Harris had originally been Hurst's successor as auditor of factory accounts in 1894.

CHAPTER 9

Contribution of this Thesis

Contribution

Much of the 'bad press' of the Ordnance Factories has been generated because little in-depth analytical historical research has previously been attempted. Comparative recent research into munitions manufacture generally (Trebilcock, 1966, 1969, 1973) or of the Ministry of Munitions in particular (Adams, 1978) tend to rely too much on bibliography written by the political masters of munitions production during the First World War (Addison, 1934; Lloyd-George, 1938). They assumed that the apparent inefficiency of the Ordnance Factories in a period from 1914 onwards, when a quick-fix solution of a three-month short war, quickly degenerated into a war of attrition which few had foreseen. The previous planning for a European war set objectives for munitions production for a war of three months' duration only. The events after October 1914, the First Battle of Ypres and the entrenchment of the belligerent armies on the Western Front by Christmas 1914 not only made the pre-1914 Order of Battle plan obsolete but it had failed to identify the sort of war which would emerge. Yet there were signs which suggested that a protracted European war could be possible. Evidence that this was possible came from warfare fought in the nineteenth century including the Crimean War and the American Civil War. Both these wars had experienced trench and siege warfare, where prolonged heavy artillery bombardment was the norm. Again, both these wars had involved civilian targets and casualties. Not least for the British imperial armies was the more recent experience of the second Anglo-Boer War, a war which was predicted to last for three months and in fact lasted for almost three years. This war also experienced similar tactics and weaponry later used on a greater scale during the First World War. The second Anglo-Boer War is also remembered for its high losses of both civilians and combatants.

Other historians, notably Marriner (1994) and Loft (1986, 1990, 1994) tend to be biased towards accountants and change in the wartime Ministry of Munitions. The only comprehensive account written about the Ordnance Factories was Hogg's *History of the Royal Arsenal* (volumes 1 and 2), published in 1963. Unfortunately Hogg's history is lacking in comparative historical analysis and concerns itself with the Royal Arsenal only and not the Royal Enfield Rifle Factory nor the Royal Gunpowder Factory. Hogg wrote in the style of a chronological regimented history and this style is also evident in the official twelve-volume *History of the Ministry of Munitions*. Yet Hogg's history remains the fulcrum of any historical stance including the Ordnance Factories because nothing as yet has replaced it.

Little interest has also been shown by business historians into the state-owned Ordnance Factories. It has been assumed that the Ordnance Factories were second-rate as compared to the private sector. This interpretation is apparent in Davenport-Hines' biography of Sir William Anderson (DBB, 1984: 61-4), as described previously in an earlier chapter. Davenport-Hines is quick to quote from the evidence by Harris in 1919 which tends to support his premise without taking the whole context of the evidence given by Harris, which is very positive about the accounting procedures at the Royal Ordnance Factories, a point ignored by Davenport-Hines. Indeed, Harris, in his evidence, implied that the problems which did occur during the First World War were when the Ordnance Factories were under the political administration of the Ministry of Munitions, along with its 340 qualified accountants, recruited as temporary civil servants (MUN 4/6375). Scott (1962) was biased in his history of Vickers, particularly in relation to the role of the Elswick Ordnance Works and the abandonment by the War Office of the contract for Armstrong guns. Scott also suggests that

Armstrong was sacrificed by the War Office in order to uphold its decision to terminate the Elswick contract. However, no such evidence appears in primary sources to support this premise, nor does Armstrong's own testimony to Scott's premise. Ashworth's paper (1969) on naval administration in the late Victorian era stands in a league of its own in relation to the historical importance of a state-owned institution. The Admiralty dockyards were among the largest employers in eighteenth and nineteenth-century Britain. Despite this, their role has generally been ignored in any study of Britain's economic past.

There are also too few detailed biographical records in relation to the personalities behind the reforms of the Ordnance Factories. Few made the obituary notices of the *Times* newspaper. The biographical notices in the War Office Staff Lists tend only to give their War Office careers. No details are given of education and socio-economic background. Thus it was not possible to produce a detailed biography of ten leading reformers of the Ordnance Factories compared to, say, the contemporary railway industry as achieved by Gourvish (1973).

The overall aim of this thesis has therefore been to present an alternative argument to the prevailing one, which is supportive of the private sector. It is argued that the development of professional management in Britain was probably more advanced in the state-owned Ordnance Factories from 1855 onwards. The Ordnance Factories evolved from the post-Crimean War era as relatively modern factory production units, supplying a long-run production demand. By comparison, it has been shown that the contemporary engineering / metal industry in the private sector remained a small-scale craft workshop structure, dominated by the myth of a craft mentality. Together also with the small-sized structure of family capitalism in

contemporary Britain, modern production methods were not introduced into British industrial life until well into the twentieth century. The example of Brunel senior and the Portsmouth production line, and his mass production system for boot manufacture in 1812, are examples of this delay (Cooper, 1984: 222).

The management reforms were allowed to flourish in the Ordnance Factories as the managerial skills included production innovation, managing labour flexibility and research and development. Therefore the flourishing of integrated management techniques in the Ordnance Factories included:

- Costing and accounting systems including DEB from 1864.
- The production process within a factory system including interchangeability.
- Scientific management labour relations and flexibility including pieceworking.

The reforms themselves were in the main accounting-driven.

The Ordnance Factories themselves expanded during the period from 1855 to 1914 as weapons technology emerged and developed. In particular, the establishment of the pre-1854 Royal Brass Foundry (a workshop) into the Royal Gun Factory from 1858, was associated with the development of the Armstrong rifled multi-calibre gun (ranging from the 6 pounder in 1858 to the naval 64 and 100 pounder in 1864). The experiences of the Crimean War and the American Civil War, together with the tensions in Europe from 1859 to 1914 exemplified the increase in weapons technology.

Also, the Ordnance Factories flourished in the doctrine of *laissez-faire*. Public funds are not directly attracted to defence expenditure in times of peace, therefore there were incentives for internal economies and reforms within the Ordnance Factories.

The First World War period reflected short-term change for the British

economy. In certain respects the management reforms that are often credited to the experiences of the monolithic yet temporary Ministry of Munitions mask the reforms that took place in the pre-1915 Ordnance Factories. The assumed innovation and reforms of the Ministry of Munitions were only as temporary as the Ministry itself. The pre-1914 attitudes of British business and management returned in the post-1918 era. Indeed, the modern management reforms did not begin to be a permanent feature within British economic life until after the post-1945 era.

Part of the interpretation as to why the Ministry of Munitions has been perceived as an innovator of these reforms, together with an assumed inefficient system of Ordnance Factories, is due to the retrenched policies as described. Unfortunately, this interpretation has been incorporated into the historiography of British history generally, either through the ignorance of the pre-1914 establishment or through misinterpretation. Historians generally, when assessing the shell scandal of 1915, forget that the whole strategy involved in the planning of the order of battle (ORBAT) of a European war from the beginning of the twentieth century assumed that it would last for only three months, a point made earlier in this chapter.

Regarding management in terms of public policy, concern with productivity has historically arisen in three contexts:

"First, from a focus of unemployment and the argument that real wage growth was outstripping productivity increases and so reducing the demand for labour.

Secondly, productivity has come into focus when output has been supply-constrained. The First World War, by calling on British industry as a key resource, focused attention on industrial efficiency.

Thirdly, concerns arising from the perception of a supply-constrained economy have led to international comparisons which in turn slide into a concern with international competitiveness." (Tomlinson, 1994: 169)

The first concept relates to the *laissez-faire* economic liberalism which was the prevailing doctrine under various shades until 1914, whereas the second concept is very much the ethos of the First World War. The third concept can be identified with the post-1918 era.

However, other factors must be taken into consideration when assessing the inability for the management reforms of the First World War to continue during the post-1918 era. First, the concept of family capitalism prevailed until well into the twentieth century in Britain (Payne, 1967; Chandler, 1996). Secondly, as part of the settlement with capital and labour for the passing of the Munitions of War Act 1915, legislation was quickly enacted in August 1919 to return capital and labour practices to the status quo as existed in 1914. This was achieved by the Restoration of Pre-War Practices Act 1919 which returned certain trade practices including demarcation and the closed shop. This Act was also responsible for the removal of women from industry in favour of the returning men from the War. Also the 1919 Act statutorily imposed differing rates of pay for women, reflecting the assumption that their contribution at work was of lesser value (Howe, 1999: 415). This Act has often been ignored by historians attempting to explain the reduction of management reforms after 1918. The 1919 Act was probably the catalyst for the demise of such post-war reforming organisations as the Works Management Association and the Institute of Industrial Management and indeed the whole of the rationalisation movement in Britain as identified by Wilson (1995: 156).

The thesis has explored management concepts in decision-making such as costing, financial management and accounting (including DEB), this leading into production process management, scientific management and industrial relations

generally. It is argued that this thesis has incorporated a new insight into government accounting. This is an important concept as Anderson has stated that very few scholars have "dedicated themselves" to government accounting (Anderson, 1994: 67). This point has also been made by Carnegie and Napier (1996). The reason for this academic neglect may be due to the assumed simplification of such accounting as reflecting a cash input / output only. However, accounting historians have tended to ignore generally how accounting reforms interfaced with other managerial components such as production control and labour relations.

The focus of the development on the War Office administered Ordnance Factories, especially with regard to their reformed accounting dimensions, drove other managerial reforms relating to production process control and industrial relations reforms. The catalyst for these reforms probably lay more in the increasing professionalism of the civil service from 1853, as was evident from the senior management of the Ordnance Factories, rather than from the soldier-technologist which was much more apparent in the American federal armories and railroads.

Great pressure for efficiency was placed upon the War Office in general and the management of the Ordnance Factories in particular. An examination of the evidence has led to the suggestion that a professional management ethos did emerge within the Ordnance Factories from the mid-nineteenth century. From an interpretation of the evidence, it is also argued that much of the alleged reforms of the Ministry of Munitions during the First World War had been introduced in the pre-1914 Ordnance Factories. This thesis argues that there is evidence to show that the Ordnance Factories from 1855 to 1914 reflected a professional management ethos superior to the contemporary private sector, particularly in the engineering / metal industries.

In the foreword of the Consultation (Green) Paper on RAB (Cm 2626, July 1994: iii), the then Chancellor of the Exchequer stated that:

"Resource accounting will enable managers in departments to evaluate the cost of using capital and current resources on an equivalent basis. It will strengthen cash management in departments. Crucially, it will also provide a much better means that we have ever had for setting departmental objectives and outputs in terms of resources used."

This statement has been made in the ignorance of history for, as this thesis has sought to demonstrate, the principles of RAB were being used quite extensively by the managers in the pre-1914 Ordnance Factories. What is unfortunate about central government departments in Britain is the neglect shown by economic and business historians as to their origins and development prior to the twentieth century. Little has been done to analytically research the pre-1914 Ordnance Factories. The two-volume history compiled by Hogg in 1963 is neither analytical nor in depth, yet to date it is the only history that has been compiled.

The introduction of RAB (or Project CAPITAL as it is called in the MoD) is part of a wider programme of both civil service and military reforms. The overall civil service reforms began during the 1980s and in particular the Next Steps initiatives from 1988. The Next Steps initiatives began to revolutionise the control management and finance of the civil service in Britain. In particular the initiatives began to introduce a business enterprise ethos with the civil service and central government departments.

The Next Steps initiatives include the restructuring of civil service departments into agency status executives, which are managed on a day-to-day basis by a chief executive. An example of this from the MoD is the devolvement of the original MoD (Procurement Executive (PE) formed in 1971) into the Defence Procurement Agency

(DPA) in 1993. Since 1997 the DPA has encroached on the philosophy of smart procurement, which includes Integrated Project Teams or IPTs. Each IPT comprises civil service and military members and members from industry representing innovator supplier and final customer in the development of each particular project. The DPA's relationship with other MoD agency users such as the MoD Ships Support Agency (SSA) is one of customer or client.

Other reforms include the devolvement of management strategies including devolved budget holders down to intermediary management levels, under the New Management Strategies (NMS) which were introduced into the civil service in 1991. One year later, in 1992, came the introduction of a revolutionary scheme of public sector finance under the public / private initiatives known as the Private Finance Initiative (PFI). Schemes involving PFI funding in the MoD include long-term contracts to private companies to train military helicopter pilots, maintain MoD housing stocks and providing the lecturing and teaching staff at the new joint service staff college at Watchfield, Oxfordshire. The introduction of RAB or Project CAPITAL from 1995 onwards is an integrated part of these reforms which will focus more on subject rather than object accounting, using conventions recognised by the professional accounting bodies.

Related to these reforms within the civil service are the external international events which include the collapse of the Soviet Union and the end of the Cold War. This has radically altered the role and order of battle (ORBAT) of the British armed services. The era of the Cold War tended to stabilise the role deployment and training needs for the armed services. Now, however, the armed services need to be very much more flexible and to be sensitive to rapid deployment or change at short notice.

Equally, the British armed services have been downsized and much more of its role has been delegated to the voluntary reserve forces such as the Territorial Army. In this context the armed services are now deployed within a similar scenario as existed prior to 1914 and from 1919 to 1938. The micro-reforms of the War Office controlled Ordnance Factories during the latter half of the nineteenth century which cumulated in the Cost Accounting Experiment in the British Army (1917-25) reflected similarities with the present-day reforms. However, the demise of the Cost Accounting Experiment in the British Army, as piloted by Sir Charles Harris, failed because schemes such as PFI, NMS and executive agency status were a bridge too far from any government of the time and subsequently. This is evident from the philosophy behind the 1950 Crick Report (Cmnd 7969).

Historians writing about the Ministry of Munitions (Marriner, 1994; Loft, 1988, 1990, 1994) tend to highlight the apparent efficiency and success of the Ministry on the inclusion of professional accountants into the Ministry as temporary civil servants. There tends to be a bias towards the role of accountants and the apparent reforms of the Ministry of Munitions, no doubt because both Marriner and Loft came from the accounting profession. Indeed, accounting history, in assessing the professional accountant, is largely the history of the financial accountant. Management accountants have not had the same success historically and, of the financial accountants, the glory has always gone to the oldest and "traditionally the most elevated body" (Quail, 1999: 122). Again, two points which are often ignored by British accounting historians are, first, the fact that "UK business was extremely poor at recruiting for management until well after World War Two" (Quail, 1999: 122). Secondly, the rise of the British accountancy profession from 1880 onwards is contemporary with the

economic decline of Britain.

The failures from 1914 in munitions production have been blamed on the apparent and hypothetical long-term inefficiencies of the Ordnance Factories. This myth has been allowed to become part of the historiography of British history in any appreciation of the First World War. The reason why this has happened is because so little research has been conducted into the pre-1914 Ordnance Factories.

The overall aim of this thesis has been to present an alternative argument to the prevailing one, which supports the private sector. It is argued that the development of professional management in Britain was probably more advanced in the state-owned Ordnance Factories from 1855 onwards. The Ordnance Factories evolved from the post-Crimean War era as relatively modern factory production units, supplying a long-run production demand. By comparison, it has been shown that the contemporary engineering / metal industry in the private sector remained a small-scale craft workshop structure dominated by the myth of a craft mentality. Together also with the small-sized structure of family capitalism in contemporary Britain, modern production methods were not introduced into British industrial life until well into the twentieth century. The example of Brunel senior and the Portsmouth production line, and his mass production system for boot manufacture in 1812, are examples of this delay (Cooper, 1984: 222).

However, there are areas of government in the nineteenth century which could also enlighten our knowledge of public sector management and accounting procedures generally. More in-depth research needs to be undertaken into naval administration from 1834. In many respects, the reforms of the Royal Dockyards and naval victualling yards was the model for the reforms of the Ordnance Factories.

Indeed, other government trading departments such as the General Post Office appear also to be a neglected topic. The Victorian Post Office was possibly the largest department in the home Civil Service during the nineteenth century, yet very little research has been undertaken in this area.

Also there is scope for further research to be conducted into the management of the Ordnance Factories under Ministry of Munitions supervision during the First World War, compared with their performance under Ministry of Supply control during the Second World War.

Ashton (1953), in his volume 'Contracts and Finance', demonstrates that munitions procurement during the Second World War was not contracted by a temporary monolithic ministry but was split between three permanent ministries. The Ministry of Supply had been formed by Chamberlain just prior to the commencement of the Second World War. Aviation procurement was under the auspices of the Ministry of Aircraft Production and the Board of the Admiralty, though notably its subordinate, the Directorate of Naval Construction, was responsible for matters of procurement of ships and associated matters. Linking these three major ministries were Treasury Inter-Service Committees (TISC). The Royal Ordnance Factories (ROF) came under the jurisdiction of the Ministry of Supply during the Second World War. Unlike the Ministry of Munitions during the First World War, each of the ministries during the Second World War were given full authority to sanction their own expenditure (Ashton, 1953: 16).

Lessons had been learnt from the First World War from the rather inflexible and cumbersome Ministry of Munitions. Prior to and during the First World War, both the Directors of Army and Navy Contracts had carried out their respective duties

quite independently of each other. However, from December 1920 a Contractors Coordinating Committee was established as

"... a result of a Cabinet decision which stated that the object was 'to secure economy and eliminate the forcing up of prices by competition' among the three Service Departments. Membership was originally limited to the Directors of Contracts of the Service Departments, who took the Chair in rotation, but in 1927, at the suggestion of the Estimates Committee ... it was extended to representatives of the Treasury, the Post Office and the Office of Works." (Ashton, 1953: 25)

It is unfortunate, however, that no reference has been made by previous historians of the First and Second World Wars, including Ashton, relating to armament and munitions manufacture of the pre-1914 Ordnance Factories. Most references to the pre-1914 Ordnance Factories are directed at Hogg (1963). Sadly, Hogg's work is very regimented and lacks analytical discourse. This promotes the concept that the Ordnance Factories were therefore inefficient. The major objective of this thesis has been to address this shortcoming.

Again, the focus of this thesis has been to address the experiences of the state-owned Ordnance Factories in relation to their organisational business and management roles and experience. Comparisons with contemporary private sector organisations can be useful to future researchers in business history generally rather than the military historian. Other comparative studies of the Ordnance Factories of the second half of the nineteenth century compared with the contemporary Naval Dockyards could exemplify research not only into allied private sector institutions but also in our current understanding of the First World War period.

This research has proved that the aspect of management of a public sector institution such as the War Office controlled Ordnance Factories in the nineteenth century is far from simple. Again, the survival of the Ordnance Factories and the

Royal Dockyards in an era of economic liberalism was due mainly to internally sponsored reforms which were implemented mainly by civil servants supported by soldier-technologist superintendents, in order to satisfy the best practice of private enterprise. By this strategy both the Ordnance Factories and naval dockyards survived in the era of *laissez faire*.

This thesis has explored the transition of munitions production in the War Office controlled Ordnance Factories from workshop to factory production from the mid-nineteenth century onwards. The transition was established in a very short time span, spurred on by the failures learnt during the Crimean War (1854-56) and the increased development in weapons technology, notably the multi-calibre rifled Armstrong and Fraser guns, and the introduction of interchangeability production processes first at the Royal Small Arms Factory, Enfield and the Royal Laboratory, then at the Royal Gun Factory. Such transitions in institutional and production processes were conducted in a post-Crimean War period and in a harsh political climate of economic liberalism which prevailed throughout the nineteenth century. This was a positive attribute towards the mainly internal reforms of the Ordnance Factories from 1855 onwards.

These reforms were similar to those experienced in America though of course these were on a much larger scale, encompassing more types of industry. The Ordnance Factories themselves as public sector institutions were totally divorced from the smaller scale family capitalism ethos of the private sector in Britain. This thesis will have made a useful contribution if it has shown that public sector industrial activities are not *ipso facto* less efficient than those in the private sector.

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